Acc # 363

BULLETIN

OF THE

UNITED STATES FISH COMMISSION.

VOL. VI,

FOR

1886.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1887.

JOINT RESOLUTION authorizing the Public Printer to print reports of the United States Fish Commissioner upon new discoveries in regard to fish-culture.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Public Printer be, and he hereby is, instructed to print and stereotype, from time to time, any matter furnished him by the United States Commissioner of Fish and Fisheries relative to new observations, discoveries, and applications connected with fish-culture and the fisheries, to be capable of being distributed in parts, and the whole to form an annual volume or bulletin not exceeding five hundred pages. The extra edition of said work shall consist of five thousand copies, of which two thousand five hundred shall be for the use of the House of Representatives, one thousand for the use of the Senate, and one thousand five hundred for the use of the Commissioner of Fish and Fisheries.

ADVERTISEMENT.

UNITED STATES COMMISSION OF FISH AND FISHERIES,
Washington, D. C.

For the purpose of utilizing and of promptly publishing the large amount of interesting correspondence of the Fish Commission in reference to matters pertaining to fish-culture and to the apparatus, methods, and results of the fisheries, Congress, on the 14th day of February, 1881, by joint resolution (H. Res. 372), authorized the publication annually of a Bulletin, a portion of the edition to be distributed signature by signature, and the remainder in bound volumes. The present volume is the sixth of this series, and contains many announcements which are believed to be of great importance in relation to the subject in question.

Mr. Chas. W. Smiley is the Editor of this volume.

SPENCER F. BAIRD,
Commissioner.

TABLE OF CONTENTS.

PERIODICALS AND MISCELLANEOUS.

TOPICAL SYNOPSIS OF THE ARTICLES AND NOTES.

[NOTE.—The references are to the pages.]

A.—UNITED STATES FISH COMMISSION—GENERAL.

B.—THE FISHERIES.

C.—NATURAL HISTORY OF AQUATIC LIFE.

D.—CULTURE OF AQUATIC FORMS.

E.—MISCELLANEOUS.

LIST OF ILLUSTRATIONS.

VEGETABLE PARASITES OF CODFISH.—FARLOW.

DEVELOPMENT OF THE TOADFISH.—RYDER.

CLEAVAGE OF BLASTODISK OF SKATE.—RYDER.

DRYING CODFISH AT BORDEAUX.—GUNDERSEN.

OYSTER CULTURE.—BOUCHON-BRANDELY.

BELGIAN FISH-CULTURE.

CARP PONDS.—GROSS.

GRAY WHALE OF CALIFORNIA.—TOWNSEND.

FISH-DESTROYING BUGS.—DIMMOCK.

KNIFE FOUND IN CODFISH.—COLLINS.

BULLETIN

OF THE

UNITED STATES FISH COMMISSION.

1886.

1.—VEGETABLE PARASITES OF CODFISH.

By W. G. FARLOW.

In the Report of the U. S. Fish Commissioner for 1878 (Washington, 1880), I gave an account of the alga, or, more properly, the schizomycete, which causes the reddening of codfish, that has proved a source of serious trouble to the fishermen of Gloucester. In the same article there was described a second parasite, *Sarcina morrhuæ* Farlow, found growing with the *Clathrocystis roseo-persicina* Cohn, the species which causes the redness. Since the publication of the above-named article, the peculiar redness, which up to that time was known only on our coast, has been observed in other countries. As the accounts of its occurrence have been published in journals which are not often read in this country, the following statement of what is known about the trouble in foreign countries may be of interest.

In the *Journal de Médecine de l'Algérie*, 1884, p. 6, Dr. E. Bertherand gave an account of poisoning which occurred among the troops encamped at Sidi-Bel-Abbès and in the neighborhood of Algiers. The trouble, which lasted but a short time, is said to have been caused by eating dried codfish which had become "échauffée," to use the local expression. The fish eaten had a vermilion tint along the spine, and the discoloration was not merely superficial, but extended also to the flesh. The color was attributed by M. Mégnin to the growth of a fungus, which he named *Coniothecium bertherandi*. A description and figure of the fungus were given in the *Revue Mycologique*, Vol. VI, p. 114, pl. 46, f. 3.

Thinking that there might be some connection between the fungus found in Algiers and the *Sarcina* of our coast, I communicated to the editor of the *Revue* a notice* of the *Clathrocystis* and *Sarcina* known

*L. c., Vol. VI, p. 197. Maladies des morues sèches, par W. G. Farlow, October, 1884.

on our coast, together with a description and figure of a third species, *Oidium pulvinatum* Farlow, found on codfish sent from Gloucester by Prof. A. Hyatt. In the *Revue* for January, 1885, the editor, M. Casimir Roumeguère, under the title of "Observations sur le *Coniothecium bertherandi*," raised the question of the identity of the *Coniothecium* of Algiers with our *Clathrocystis*—a point which could not well be settled by the description and figure of M. Mégnin.

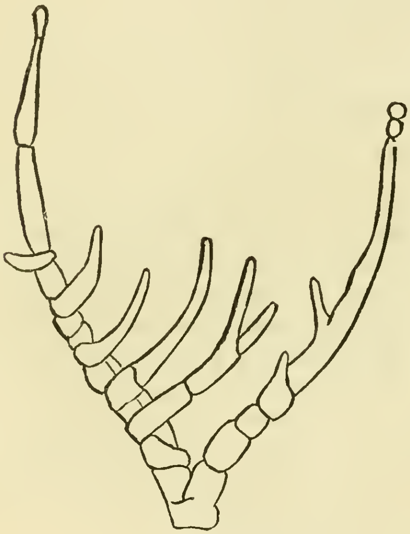


FIG. 1.

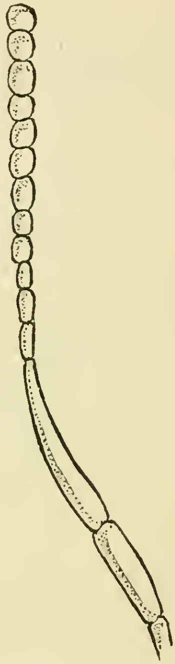


FIG. 2.

TORULA PULVINATA.—Fig. 1. Young fructiferous hyphæ. Fig. 2. A chain of mature spores, magnified 700 diameters.

The subject was still further discussed in the *Revue* for April, where a number of interesting facts with regard to the prevalence of the redness in France were cited. Specimens of red fish were received from Bordeaux and Dieppe, and the redness was recognized by Roumeguère and Patouillard as due to the presence of *Clathrocystis*. On the testimony of an eye-witness it is stated that in the market of Algiers fish have been seen in which the redness had reached a stage such that the flesh was so deliquescent that, on attempting to lift the codfish, the tail separated from the body. From all accounts there seems to be no doubt that sickness was produced as a result of eating the red fish in Algiers. On the other hand, according to M. Couédic, no harm has arisen in France from this cause, for, unless the redness has reached an advanced stage, it may be scraped from the surface, and what remains of the fish is uninjured. It may be remarked that the fish found at Dieppe had

come from the Newfoundland fisheries, and I presume that the same is true of those from Bordeaux, although I have no definite information on this point, nor is there any mention of the kind of salt generally used in the French fisheries.

A word should be said in relation to the distribution of the *Sarcina morrhuæ* and *Oidium pulvinatum*. After my note in the Report of 1878 had gone to press, there appeared a paper* by Poulsen, in which he described a new species, *Sarcina litoralis*, found on mud near Copenhagen. As the description of Poulsen's species corresponded very nearly to my *S. morrhuæ*, I sent a specimen of the latter species to the Danish botanist, who expressed the opinion that, in spite of a difference in the micrometric measurements, it was the same as his *S. litoralis*. As the latter name appeared in print before the Report of 1878, it has priority. The most recent reference to the *Sarcina* is in the *Miscellanea Mycologica* † of Saccardo and Berlese, who recognized the species on the surface of codfish sent from Algiers by Prof. L. Trabut. They consider the *Coniothecium bertherandi* of Mégnin to be identical with *S. litoralis* Poulsen, which they state is considered by Zopf a condition of *Beggiatoa roseo-persicina*, under which name Zopf includes *Clathrocystis roseo-persicina* as a zoöglœa form. Both in this country and Algiers the *Sarcina* is found in company with the *Clathrocystis*, but it does not seem to me to be well proved that the two forms belong to the same species. As it occurs on our coast, the *Sarcina* is quite destitute of any purple or rose color, and the size of the cells as well as their conformation does not lend any support to the view that the *Sarcina* is a stage of the *Beggiatoa*. In the present connection the point of interest is that the *Sarcina* is found on codfish in countries as far apart as New England and Algiers, and on mud in salt marshes in Denmark. A *Sarcina* was found by Patouillard on salted pork, and he thinks it probable that the species is the same as that found on codfish. If this supposition is correct, we have in the *Sarcina* a form which may have been communicated to the codfish by the salt used in curing. In general, it may be said that, with the exception of the long-known *Sarcina ventriculi*, but little is known by botanists of the species of this genus.

The third species, *Oidium pulvinatum* Farlow, is a distinctly higher form than the others. It forms small brown spots on the surface of the dried cod, and is said to injure the sale of the fish; but I do not possess any definite information about the extent of the injury. The fungus would be placed by botanists in the *Hyphomycetes*, and I was in doubt whether to consider it a *Torula* or an *Oidium*. The color and texture of the spores remind one rather of *Torula*, while, on the other hand, the ramification and pulvinate character of the mycelium resemble rather certain forms formerly referred to *Oidium*. The name *Oidium pulvinatum*

* Om nogle mikroskopiske Planteorganismen, V. A. Poulsen. Vidensk. Meddel. naturh. Foren., Copenhagen. 1880.

† Atti del R. Istituto Veneto, Ser. VI, Vol. 3.

must be abandoned, however, as there is already a species of that name, and in the *Revue Mycologique* of January, 1885, I proposed to substitute the name *O. morrhuæ*. In the article of Saccardo and Berlese before mentioned, this species is said to occur in Algiers in company with *Clathrocystis* and *Sarcina*, and they consider it a *Torula* rather than an *Oidium*, adopting the name *T. pulvinata*. Patouillard also found on salted pork a fungus which he thinks probably belongs to the same species. As the specific description was originally given in the *Revue Mycologique* the following translation may be of service to those who do not have access to that journal: "Spores spherical, 3.5–5 μ in diameter, fuscous, attached in chains (average 12–15), arising from secundly fasciculate hyphæ, which are pulvinately compacted in scattered spots."

2.—PRELIMINARY NOTICE OF THE DEVELOPMENT OF THE TOAD-FISH, BATRACHUS TAU.

By JOHN A. RYDER.

The ova of this fish are large, and measure from 5 to 5½ millimeters in diameter. They are dirty yellow, almost amber colored, and adherent to the surfaces of submerged objects, especially the under sides of bowlders, under which the parent fish seem to clear away the mud and thus form a retreat in which they may spawn. The ova are attached to the roof of the little retreat prepared by the adults, where the eggs are found spread over an area about as large as one's hand in a single layer, hardly in contact with each other, and to the number of about 200. A discoidal area about 3 millimeters in diameter at the upper surface of each egg glues the latter firmly to the supporting surface (Fig. 4).

Fertilization of the ova probably occurs at the time of their extrusion by the female, which, like the female catfish, manifests no further interest in her offspring. The male at once assumes the care of the brood, and seems to remain in the vicinity until the young fish are hatched out and set free.

The germinal disk is developed at the under or inferior pole of the vitellus and opposite the point where the ovum is attached to the roof of the retreat by its adhesive membrane (Fig. 4). There are no oil globules in the yelk, the latter seeming to be remarkably homogeneous. It is therefore not very clear what it is that determines the inferior and inverted position of the blastodisk.

Equally remarkable is the fact that as development proceeds the young adherent embryos are found to have their heads directed towards the opening of their retreat and their tails towards its blind and dark extremity (Fig. 5). This appears to be invariably the case, and it would seem that the direction from which light comes in this instance, at least, has a great deal to do in determining the direction of the axis

of the body of the future embryo. This position of the young fishes is maintained as long as they are attached.

The development, as it advances, enables the young embryo within the egg-membrane to finally rupture the latter immediately over the back, which looks down and away from the surface to which the egg is attached. When the zona or egg-membrane is ruptured (Fig. 2) the young fish is, however, not set free at once, as in the case of other adhesive ova, but remains firmly glued to the inside of the zona over a part of the ventral surface of the yelk-bag. This adhesion of the yelk-bag to the zona takes place over about the same area on the inside of the latter as that which on the outside is adherent to the stone or other object, which affords support to the whole egg and embryo. It results in this way that the egg-membrane is not cast off from the embryo at once, but remnants of it continue to cover the sides and lower surface of the yelk some time after the embryo has ruptured the zona and commenced to respire from the surrounding water by means of its gills, but while still affixed to the surface to which the eggs were originally caused to adhere by the parent fishes (Figs. 1 and 2). Whether the substance which causes the yelk-bag to adhere to the inside of the zona is secreted at the time of oviposition, or whether it is secreted during a later stage of development has not been determined; but it is inferred that this adhesion is a secondary phenomenon, and takes place after the vitellus has been covered by the blastoderm, for the reason that the latter alone is adherent. In fact, if the vitellus were primarily adherent, the blastoderm could not grow around the vitellus and over the area where the former becomes adherent to the zona radiata.

While the embryos are still adherent, the tail is not kept constantly vibrating, but the pectoral fins are kept in motion so as to keep up currents of water and effect the constant change of the latter, needful for the respiration of the embryos.

For a considerable time the yelk-bag is almost pyriform, with its adherent base flattened and its upper narrowed end in relation with the embryo and its vessels and heart. Vessels are developed over the surface of the vitellus long before hatching. With the progress of development the vitellus suffers constriction (Fig. 1), so that it is divided into an upper portion, which is included by the down-growing myotomes of the body cavity, and a lower portion which is covered by the thinner epiblastic and mesoblastic covering of the inferior pole of the yelk. When the embryos are detached from the surface to which they adhere, the free, bulbous lower portion of the yelk-sack becomes wrinkled in consequence of the thin epiblastic and mesoblastic investment being thrown into narrow folds, which run horizontally around the yelk.

With the extension of the abdominal walls over the yelk, more and more of the yelk is finally taken into the abdominal cavity proper, and a transverse constriction around its middle is finally developed, so that it becomes hour-glass shaped. The upper bulb of this yelk mass is in-

tra-abdominal, and the lower bulb is invested by a thinner portion of the abdominal wall and adherent to the surface upon which the eggs were originally laid. The embryos apparently remain affixed by their yelk-bags until they reach the length of somewhat more than half an inch, when they present nearly the form of their parents. The same broad, flat, depressed head as seen in the adult is already well marked. They are also well pigmented by this time, four broad lateral and transverse bands of color showing on the nape and tail. By this time also the inferior bulb of the yelk-sack is becoming smaller, and it is apparent that the whole of its contents will become intra-abdominal. Soon after this the young become detached from the surface to which the egg adhered originally. Judging from the slowness with which the early stages are passed over, I infer that the fixed condition of the egg and embryo lasts for at least three or four weeks. The egg-membrane is ruptured in apparently about half that time. The period of incubation of this species is therefore somewhere about fifteen to twenty days, but the exact duration of its development was not determined, so that this period is only given as approximate.

In this species I have witnessed the origin of the pelvic fins from a pair of minute horizontal folds (Figs. 2 and 3), which grow out just behind the pectoral folds. They develop somewhat later than the pectoral folds and appear just about the time that the egg-membrane is ruptured over the back of the embryo or when the latter bursts the bonds imposed upon it by its covering. The original position of the pelvic fins behind the pectoral does not last long, however, for in three or four days one begins to notice that the pelvic fin folds are beginning to advance and are being apparently shoved forward below the pectorals into their permanent position. This is before the embryo is quite three-eighths of an inch long. By the time the young fish is a little over one-half of an inch in length the translocation of the pelvic fins is completed. They are then inserted in advance of the base of the pectorals (Fig. 1).

I have not made any sections of these embryos, but a dissection of the adult fish shows that the spinal nerves which pass out to the pelvic fins, arise behind those which pass to the pectorals but cross the nerves going to the latter and are inserted in advance of them into the translocated pelvic fin, which we saw arose originally in a position to the rear of the pectoral. The paired nerves going to the pectoral are given off from the spinal cord, and pass out just in advance of the first, second, and third vertebræ; those passing to the pelvic or ventral fins pass out in advance of the fourth and fifth thoracic vertebræ, and a twig seems also to be sent off from the third pair. We have therefore been able to trace the stages of development of the nerves which pass to the paired fins up to their completed state in the adult, and thus put beyond question the data upon which the doctrine of the translocation of the paired fins rests.

The development of the median fins of *Batrachus* is more direct than usual in young fishes; that is to say, the atrophy of certain portions of the fold are not extensive, because the median fins of the adult are almost continuous.

The larval integument, when sections of it are prepared, is shown to be very thickly covered with muciparous unicellular glands, similar to those observed in the salmon.

The lateral line system is very well developed and begins to show itself very distinctly before the embryo is half an inch in length. The portions continued over the head and lower jaw remain open until the young fish is about a half-inch in length; after that the edges of what were open grooves coalesce and in that way the closed canals over the head are formed. At short intervals, however, the edges of the grooves do not close, and these open spaces in the outer walls of the mucodermal or neuromastic canals form the pores which open into the lateral line system from the outside.

This system is not, as is usually the case in other fishes, prolonged backwards on either side of the body and tail of the Toad-fish as a single canal, but divides behind the hyomandibular into a ventral and a dorsal canal, each of which passes along nearly parallel close to the base of the dorsal and anal fins respectively. The upper one of these canals passes along above the insertion of the pectoral, and the lower one passes below the base of that fin.

In the adult the pores which open outwards from the system of lateral canals are not simple openings without defense of any sort; on the contrary, those on the head, body, and tail are always defended by a pair of strongly-developed papillæ, which almost completely conceal the pore opening between their bases. On the body one of the papillæ arises below the pore and another above it. These paired papillæ are best developed on the head and jaws, and they gradually become more and more rudimentary towards the tail. No evidence of the development of these papillæ can be found on any of the later larval stages in my possession, so that it is obvious that they are of post-larval origin.

The anterior nareal opening in the embryo of *Batrachus* is quite near the middle line, and is produced into a tubular prolongation before the young fish reaches the length of one-half inch. The posterior nareal opening, on the contrary, is a simple pore, and stands farther from the middle line than the anterior one.

Judging from the highly specialized character of the lateral line system of canals in *Batrachus*, and the pores, connecting canals, papillæ, and nerves which pass to the apparatus, it is obvious that the latter is quite complex and must subserve some very important function. That its sole function is to secrete mucus is absurd on its own face, even if we had no direct experimental evidence to show that these organs are the instruments of a special sense. In mounted preparations of the skin of the larvæ, prepared for me by Professor Libbey, it may readily be

shown that the pores are joined together by a canal, and that a nerve probably extends along its whole length. In the adult the integument of the first ray of the ventral pair of fins is thrown into numerous narrow transverse folds. The distribution of the nerves to this structure or its histology I have not worked out, but I think it very probable that in it we have a specialized tract of the integument which may be highly sensitive as a tactile organ and be of service to the fish in finding its food on the bottom where it habitually lives.

I must take occasion here to express my obligations to Mr. Vinal N. Edwards for assistance in obtaining the materials upon which this notice is based. All of the materials were obtained under submerged stones and stumps in the eel pond at Wood's Holl during the latter part of July, 1885.

EXPLANATION OF THE PLATE.

FIG. 1. Advanced embryo of *Batrachus* or Toad-fish, still adherent; the pelvic fin has been translocated forwards. Enlarged about 12 times.

FIG. 2. An embryo Toad-fish, from the side which has recently ruptured the egg-membrane, a remnant of which still remains around the yelk-bag. The pelvic fin is shown as a small bud-like prominence just behind the pectoral fold.

FIG. 3. The same seen from above, showing the paired fin folds resting with their bases apparently upon the yelk, outward a little way from the sides of the body of the embryo.

FIG. 4. Egg of Toad-fish, with spreading blastoderm, in its natural position and adherent.

FIG. 5. A group of four developing eggs of the Toad-fish, adherent to a fragment of bark, to show that the heads of the contained embryos are all directed one way. Natural size.

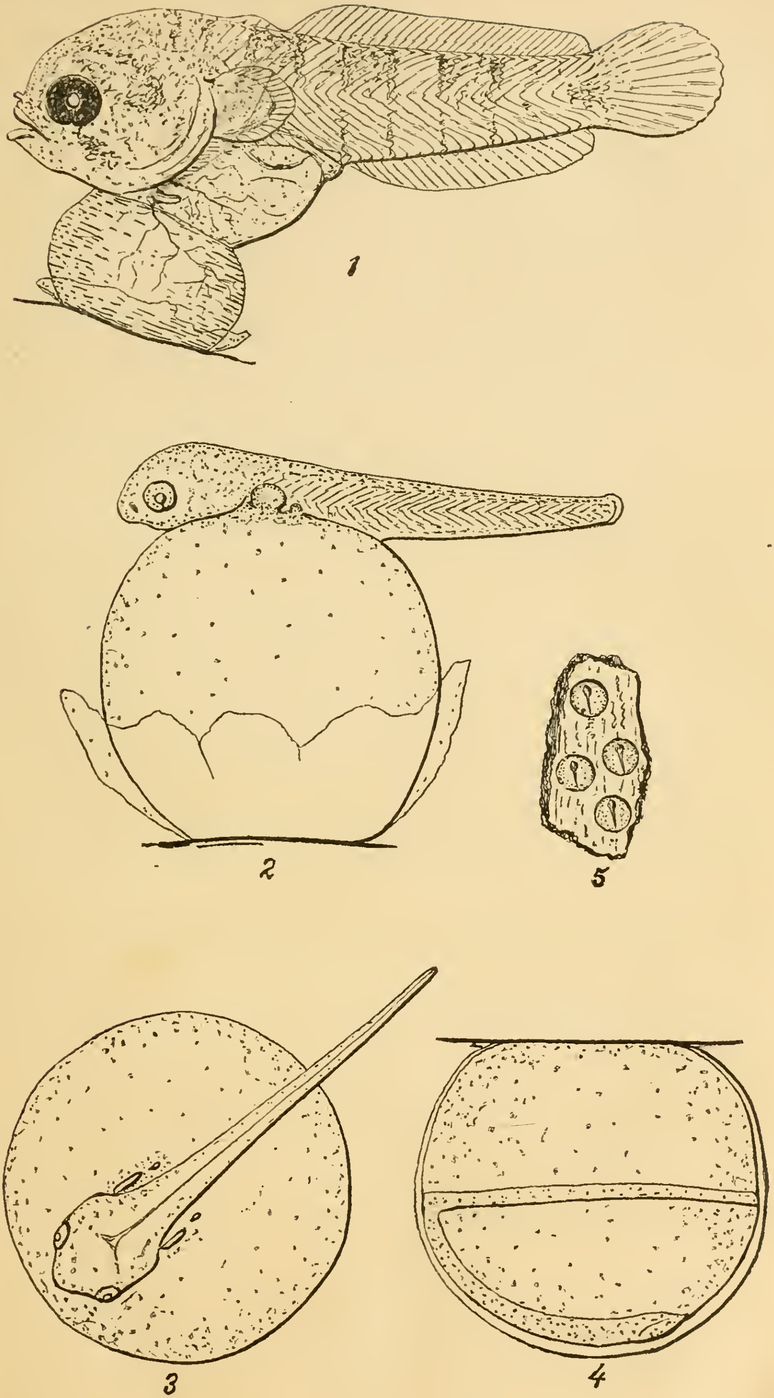
3.—ON THE EARLIER STAGES OF CLEAVAGE OF THE BLASTODISK OF RAIA ERINACEA.

By JOHN A. RYDER.

In the oviparous Rays fertilization of the egg takes place while it is still within the oviduct, or possibly even before it enters the latter. In an egg taken from the cloaca of a female on the 11th of July, 1885, the blastodisk was already segmented into fifteen distinctly-marked cells. The mode in which these were arranged with reference to each other showed very plainly that the mode of segmentation, during the early stages at least, is very similar to that which occurs during the development of osseous fishes, though the cleavage becomes irregular somewhat sooner than in the latter. The sequence in which the segmentations occurred may be briefly described.

From a careful study of this disk, which was hardened in chromic acid, the case having first been carefully opened to allow the reagent access to the egg and disk, it is inferred almost with absolute certainty

PLATE I.



Development of the Toadfish.

that the disk changes form somewhat in the same way as does the segmenting blastodisk of a Teleostean ovum. This conclusion is supported by the following data: The disk of an apparently unfertilized egg removed from a recently-captured female, was perfectly discoidal, whereas the disk of the nearly completed 16-celled stage was elongated and had a decidedly squarish outline when viewed from above. The latter measured 1.71 millimeters in width and 2.37 millimeters in length. Its thickness in the center was about .6 of a millimeter, and thinned out at the margin into a very thin layer of protoplasm which is obviously homologous with the periblastic layer of the Teleostean egg.

Judging from the arrangement and depth of the segmentation furrows, the first one, *I*, divided the disk into two halves, and in the process of segmentation the disk became narrowed at right angles to the plane of the first cleavage. This modification seems to have influenced the character of the subsequent cleavages, as the next furrow, *II*, is about at right angles to the first, and traverses the middle of the disk through its longest diameter. The disk is now segmented into four large cells. The next cleavage furrows, *III*, *III*, cut through the disk transversely across its least diameter, and the two of them divide the four cells resulting from the first and second cleavages into eight. These are arranged in two parallel rows of four each and embrace the long diameter of the disk, just as in the blastodisk of the Teleostean egg at the end of the third cleavage. Some irregularity now becomes apparent upon the advent of the fourth cleavage upon one side, as a result of which it is clear that the disk will soon lose its oblong, subquadrate form and become discoidal in the same way in which this happens in the eggs of bony fishes. On the right side of the blastodisk of *Raia*, the furrow, *IV*, of the fourth cleavage is quite regular, on the left very irregular, as shown in the figure.

Sections through the disk display the relation of the segmentation spheres to the vitellus. The furrows do not appear to cut quite through the less granular protoplasm of the disk, so that probably a thin periblastic stratum is left underlying the latter and immediately overlying the yelk, the coarse granules and corpuscles of which are apparent just below. The marginal cells in section have a thin border, and the outer twelve cells are wider than the four central ones when viewed from above. The thin borders of the marginal cells are directly continuous with the thin periblastic envelope which invests the vitellus.

The nuclei are relatively small, and contain rather dense single, but somewhat irregular, masses of chromatin.

Somewhat more advanced stages show the disk divided irregularly into cellular areas; the whole disk is also more nearly discoidal in form.

No later stages were observed in which the number of cellular layers had multiplied, or where the disk showed two or more superimposed strata of cells; and in none of those examined by me did I find any evidence of the presence of a developing cleavage cavity, nor was it

observed in the 16-celled stage, originating in the manner described for the Teleostean egg by Whitman. The time of the appearance of that cavity, however, seems to vary somewhat even in different species of the latter.

The striking similarity of the early stages of segmentation in the blastodisk of *Raia* to those observed in the blastodisks of Teleosts is significant, and shows that the pattern of the furrows up to the fourth cleavage, in such an extremely meroblastic (teleplasmic) type of egg, need not necessarily resemble those developed on the blastodisk of the equally extreme type *Aves*, if Coste's figures are correct. The figures of the very early cleavage patterns of the blastodisk of the bird's egg given by Coste cannot, however, be reconciled with the more recent views as to the possibly intimate relation which may subsist between the future axis of the embryo and the first cleavage plane. The detection of the essentially right-angled relation between the first four cleavage planes which segment the blastodisk of *Raia* opens up the question whether such a method of cleavage does not also take place in the blastodisk of the bird's egg. If that is the case, then the subject of the very early stages of cleavage of the *Avian* blastodisk needs reinvestigation.

A continuous series of sections was cut of the Ray's blastodisk, above described, with a Cambridge rocking microtome. In this series it was possible to follow out the cells and furrows shown in the accompanying diagram. This series of sections was prepared by cutting the disk transversely. The hardening of the disk here described was accomplished as it lay upon the subjacent yelk undisturbed. After remaining in that position for twenty-four hours in the acid, the acid was gently poured off, the egg carefully washed, and the disk loosened with the greatest care from the underlying yelk. The changes wrought by the acid in the relative positions of the cleavage furrows were too slight to be noted, as was shown by a careful examination of the surface of the blastodisk both before and after hardening.

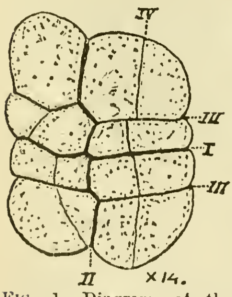


FIG. 1.—Diagram of the cleavage planes in the blastodisk of *Raia erinacea*.

4.—FISH KILLED BY POISONOUS WATER.

By A. H. GLENNAN.

[Letter to J. B. Hamilton, M. D., Surgeon-General of the Marine Hospital Service.]

Large shoals of dead fish have been met with between Egmont Key Light and Charlotte Harbor, off the mainland, and vessels have been several hours in passing through them. A few weeks ago the fishing schooner City of Havana, Capt. John Curry, lost two loads of live

fish, which were killed in sailing through strips of this poisoned water. It is said to be of a reddish color, and distinguishable for some distance from the surrounding water. Capt. Samuel Morgan, a patient in the hospital, informs me that in some of the freshwater creeks fish are caught by placing bags of the bruised bark of the swamp dogwood (*Cornus sericea*) in still water, and that the fish will revive if allowed to remain in it for a short time only. There would appear to be some connection in this, as the mortality seems to appear after considerable rainfall in the swamps and freshwater outlets, and is not due, as has been stated, to submarine volcanic action. I have mentioned the fact to Dr. Joseph Y. Porter, U. S. A., and requested him to take advantage of his proposed visit to Tampa, Fla., this week, to collect samples of the water, should the vessel pass through any of these reddish-colored strips.

KEY WEST, FLA., *October* 28, 1885.

5.—THE MORTALITY OF FISH IN THE GULF OF MEXICO.

By JOHN G. WEBB.

The answer to the question "What kills the fish?" is, in my opinion, that they are killed by noxious and poisonous gases which permeate portions of the Gulf and its bays, and which are derived from underground streams of water that flow into the sea.

First, as to the existence of underground streams of water. Everybody at all familiar with Florida is aware of the existence of enormous springs. Crystal River, in Hernando County, is an illustration. Good-sized coasters, say of 8 or 10 tons, can, I am informed, sail clear up to the spring, which issues from the ground—a river at the start. So with Silver Spring. It is described, for I have not seen it, as an immense volume of water rising in a bowl, deep and clear, and forming the Oklawaha, a river at once. So with a lake near Gainesville. My friend, Mr. F. B. Hogan, of Pine Level, in this county, tells me that, when a boy, his father resided near what is now the lake. He raised corn on the very flats which are now the bottom of this lake. There was then a small stream winding along through this flat and finally emptying into a hole in the ground, where it disappeared. In process of time somebody set up a saw-mill near this hole, propelling his machinery, if I am not mistaken, by power derived from the stream. He allowed the *débris* of his saw-mill to fall into the hole, which became stopped up. Now there is a lake there 18 miles long, and a large town gets its supply of fish from it. If the hole should again become open the lake would undoubtedly be drained.

Some years ago one of the Myaka lakes became nearly dry. It was then discovered that near the center of the lake was a deep hole, and it was furthermore discovered that the tide rose and fell in this hole.

A year or two afterward a party, of which my son was one, sounded this hole and procured some water from its bottom. The hole is 137 feet deep and the water brackish and nauseous to the taste. I live 10 miles from that place and on the Gulf of Mexico, and that hole, 10 miles inland, is more than twice as deep as the Gulf is 10 miles from the shore. You would have to go 25 miles to sea to find a place as far from the surface of the earth as the bottom of the hole in the middle of Myaka Lake.

A gentleman (Mr. T. J. Edmondson, of Tarpon Springs) informs me that he once accidentally discovered a deep hole in Sarasoto Bay, in which the water was dark and cold and fresh. He did not ascertain its depth.

Now, all these facts go to show that there are underground streams in this State, and that some of them are very large and very deep below the surface of the earth. How large we do not know, but the presumption is that there are very large ones. For the water which is discharged from our surface rivers does not, in my judgment, account for the water that falls upon the land. There is very little fall to our rivers, and all of them are stopped at their mouths by tides. The Saint John's is a large river, but it is the only one on the east coast above the Everglades. On the west coast there are a great many small streams discharging themselves into the Gulf, but every one, except the Suwanee, I think, is a tide-water creek.

Now, where these underground streams empty no one knows. The stream which the Myaka Lake is connected with may empty 25 miles at sea, for it is about on a level with the bottom of the Gulf at that distance. The surface of the lake is probably 10 feet above the surface of the Gulf, and as it certainly communicates with the tide-water, the only reason why the lake can exist with this hole in its bottom must be that the underground stream completely fills the orifice out of which it flows. Crystal River and Silver Spring are underground streams before they appear, and the Gainesville Creek was an underground stream after it disappeared; and it is not at all probable that they are the only ones or the largest ones in Florida.

Now, how should water carried into the Gulf by an underground stream poison the fish? The answer is that the rock through which the water flows contains pyrites. Pyrites is a compound of iron and sulphur, often contaminated with arsenic. Exposed to water this substance is decomposed, and the sulphur and arsenic, if that is present, unite with one of the constituents of water, hydrogen, to form one of the most poisonous gases known. It is very soluble in water, and a little water charged with it would poison a great deal of the air which the fish absorb in their gills as the water is forced through them.

As to the presence of iron pyrites in the substratum of Florida there is no doubt at all. Nothing in Manatee County is more common than iron in the well-water. Some wells furnish water so thoroughly impregnated with iron that it is unfit for the laundry. And the shores of all

the bays are more or less lined with bog iron ore which has been deposited from springs. I have seen it at Cedar Key, at Tampa, and I think it is found all over the peninsula. Sulphur almost always is found combined with all iron ores, and arsenic and phosphorus often, which latter is as poisonous combined with hydrogen as either of the substances named.

Now, during the dry season, when there is not much or any surface water, the chemical reactions I have described would be going on, and lakes of underground water (or pools, if you please) existing along the watercourses, would become saturated with these poisonous gases. When the rains come and force out into the sea this accumulated poison the fish are killed. They are killed at every flood and they are not killed except at a flood. Smack fishermen say that they sometimes observe at sea a brownish spot or area of water, and sailing into it the fish in their wells begin to die at once. In these last two mentioned facts lies the objection to the volcanic theory, for it is difficult to see what connection a flood can have with a submarine volcano, which, being submarine, should be abundantly supplied with water.

OSPREY, MANATEE CO., FLA., *December* 3, 1885.

6.—HATCHING LOBSTERS AND COD IN NORWAY.

By G. M. DANNEVIG.

[From a letter to Prof. S. F. Baird.*]

I am now engaged in hatching lobster eggs, and seem to be succeeding. During the past two days about 200 young lobsters have been hatched, and they are very lively—rather too much so, as they eat the other young ones as soon as these last come from the shell. I intend to find out what else they will eat, as their present food is rather inconvenient to furnish. The so-called artificial hatching of lobsters has often been tried before this; but in such cases simply lobsters with spawn were put into a live-box and kept there till the young hatched out; while in my experiments I take the spawn from the parent lobsters and hatch it out in a specially-constructed apparatus. If this latter method of hatching can be carried out on a large scale, of which I have no doubt, many millions of lobsters could be hatched every summer. If we could succeed in raising them for a while before planting them, so much the better. I would like to know if anything in this line has been attempted by the U. S. Fish Commission, and with what success.

Some time ago I read an account of your trying to send lobsters by rail from the Atlantic to the Pacific coast. Instead of sending the lobsters, why do you not try sending well-developed spawn? This could

* For previous letters in regard to hatching lobsters, see F. C. Bulletin, 1885, pp. 280, 446.

be conveniently hatched during transportation, so that on arrival most of the young could be liberated. I do not know how long the fry could be kept alive in the box in which they were carried, but think that an objection on this score could easily be obviated.

I have not yet overcome the difficulties in regard to the hatching of codfish. The result this year (1885) was about 24 millions of fry, which were liberated when about a week old. The longest I could keep them was for 15 days after hatching, after which period they would gradually die.

FLODEVIG, near ARENDAL, NORWAY, *June* 29, 1885.

REPLY BY PROFESSOR BAIRD.

Several experiments have been made at this station in hatching detached lobster eggs; and most success has been gained by using the McDonald glass hatching-jar, such as we now use in our shad work. Lobster eggs placed in these jars 6 or 8 weeks ago have done well, and at least two-thirds of the number are now alive, despite the fact that for the first 2 or 3 weeks we were much troubled by iron-rust and other impurities. The lots of eggs placed in the jars since then have fared much better, and we have kept them 4 or 5 weeks with scarcely any mortality. The rate of development at this time of year, however, is very slow, and we have not succeeded in hatching any young. The experiments will probably be continued during the fall and winter, and the development may be hastened by slightly increasing the temperature of the water artificially. The best results are anticipated from next year's work, and every means will be used to make a success of it, as our supply of lobsters is rapidly decreasing on all parts of the coast.

WOOD'S HOLL, MASS., *September* 19, 1885.

7.—EXPORTS OF FISH AND FISHERY PRODUCTS FROM NEWFOUNDLAND DURING 1884.

[From Customs' Returns.—W. J. S. Donnelly, receiver-general.]

Article.	Countries to which exported.	Quantities.	Average price.	Value.
Dry cod (in quintals)	United Kingdom	50,752	$3 00	$152,256
	Dominion of Canada	24,012	5 00	120,060
	United States	27,362	5 00	136,810
	British West Indies	88,758	2 60	230,771
	Spanish West Indies	10,885	2 60	28,301
	French West Indies	608	2 60	1,581
	Gibraltar	101,768	3 20	325,657
	Spain	133,872	3 80	508,713
	Portugal	318,820	4 50	1,434,690
	Sicily	15,100	3 20	48,320
	Italy	45,941	3 20	147,011
	Corfu	1,800	3 20	5,760
	Greece	2,870	3 20	9,184
	Brazil	375,089	4 20	1,575,373
Total		1,197,637		4,724,487

Exports of fish and fishery products from Newfoundland, &c.—Continued.

Articles.	Countries to which exported.	Quantities.	Average price.	Value.
Pickled fish (in quintals)	Dominion of Canada	1,040	$2 00	$2,080
	United States	615	2 00	1,230
Total		1,655		3,310
Herring (pickled), Labrador (in barrels).	United Kingdom	4,158	3 30	13,721
	Dominion of Canada	3,232	3 30	10,666
	United States	7,651	3 30	25,248
Total		15,041		49,635
Herring (pickled), shore (in barrels).	United Kingdom	2,514	1 80	4,525
	Dominion of Canada	44,461	1 80	80,030
	United States	6,994	1 80	12,589
	British West Indies	3,335	1 80	6,003
	Spanish West Indies	312	1 80	562
	Russia	903	1 80	1,625
Total		58,519		105,334
Herring, frozen (in barrels)	Dominion of Canada	2,585	1 00	2,585
	United States	16,591	1 00	16,591
Total		19,176		19,176
Salmon, pickled (in tierces)	United Kingdom	1,677⅔	13 00	21,809
	Dominion of Canada	1,049	13 00	13,637
	United States	1,832⅓	13 00	23,820
	British West Indies	315	13 00	4,095
	Spanish West Indies	241⅔	13 00	3,142
	Italy	198	13 00	2,574
	Corfu	30	13 00	390
Total		5,343⅔		69,467
Trout (in barrels)	Dominion of Canada	26	6 00	156
	United States	996	6 00	5,976
	British West Indies	28	6 00	168
	Italy	5⅓	6 00	32
Total		1,055⅓		6,332
Haddock (in quintals)	United States	376	2 60	978
	British West Indies	442	2 60	1,147
Total		818		2,125
Halibut (in quintals)	Dominion of Canada	30	6 00	180
	United States	22	6 00	132
Total		52		312
Core (in quintals)	Jersey	74	2 00	148
Mackerel (in barrels)	British West Indies	4½	3 00	14
Ling (in quintals)	do	40	2 00	80
Caplin (dried), (in barrels)	United Kingdom	45	50	22
Fish guano (in tons)	do	109¼	20 00	2,185
Tongues and sounds (in barrels).	United Kingdom	11	3 00	33
	Dominion of Canada	46	3 00	138
	United States	2	3 00	6
	Jersey	18	3 00	54
Total		77		231
Lobsters, preserved in tins (in pounds).	United Kingdom	389,616	10	38,961
	Dominion of Canada	218,208	10	21,821
Total		607,824		60,782
Cod oil (in tuns)	United Kingdom	3,035¾	128 00	388,576
	Dominion of Canada	279¼	128 00	35,744
	United States	309½	128 00	39,616
	Jersey	26½	128 00	3,392
	Portugal	6	128 00	768
	Spanish West Indies	30½	128 00	3,904
Total		3,687½		472,000

Exports of fish and fishery products from Newfoundland, &c.—Continued.

Articles.	Countries to which exported.	Quantities.	Average price.	Value.
Refined cod oil (in tuns)	United Kingdom	78½	$204 00	$16,014
	Dominion of Canada	41¼	204 00	8,415
	United States	113½	204 00	23,154
	Spanish West Indies	2	204 00	408
Total		235¼		47,991
Seal oil (in tuns)	United Kingdom	3,513	116 00	407,508
	Dominion of Canada	242½	116 00	28,130
	United States	6¼	116 00	725
	Jersey	50¼	116 00	5,829
	Hamburg	132	116 00	15,312
	Portugal	25	116 00	2,900
Total		3,969		460,404
Whale oil (in tuns)	United Kingdom	167½	116 00	19,430
	Jersey	5	116 00	580
Total		172½		20,010
Blubber (in tuns)	United Kingdom	24	16 00	384
	Dominion of Canada	21¼	16 00	340
Total		45¼		724
Shark oil (in tuns)	United Kingdom	¼	100 00	25
	Portugal	¾	100 00	75
Total		1		100
Herring oil (in tuns)	United Kingdom	11	108 00	1,188
Pitchings (in tuns)	United Kingdom	¾	48 00	36
Cod dregs (in tuns)	United Kingdom	5¾	48 00	276
Seal skins (each)	United Kingdom	259,327	1 20	311,192
	Jersey	3,460	1 20	4,152
	Dominion of Canada	23	1 20	28
	Portugal	3,480	1 20	4,176
Total		266,290		319,548
Whalebone (in cwts.)	United Kingdom	140	306 00	42,840
	Jersey	5		28
Total		145		42,868

Summary of total fishery exports.

Kind.	Quantity.	Value.	Kind.	Quantity.	Value.
Blubber ... tuns.	45¼	$724	Ling ... quintals.	40	$80
Caplin, dried ... bbls.	45	22	Lobsters, preserved ... lbs.	607,824	60,782
Cod, dry ... quintals.	1,197,637	4,724,487	Mackerel ... bbls.	4½	14
Cod dregs ... tuns.	5¾	276	Pickled fish ... quintals.	1,655	3,310
Cod oil ... do.	3,687½	472,000	Pitchings ... tuns.	¾	36
Cod oil, refined ... do.	235¼	47,991	Salmon, pickled ... tierces.	5,343⅗	69,467
Core ... quintals.	74	148	Seal oil ... tuns.	3,969	460,404
Fish guano ... tons.	109¼	2,185	Seal skins ... number.	266,290	319,548
Haddock ... quintals.	818	2,125	Shark oil ... tuns.	1	100
Halibut ... do.	52	312	Tongues and sounds ... bbls.	77	231
Herring:			Trout ... do.	1,055⅓	6,332
Frozen ... bbls.	19,176	19,176	Whalebone ... cwts.	145	42,868
Pickled, Labrador ... do.	15,041	49,635	Whale oil ... tuns.	172½	20,010
Pickled, shore ... do.	58,519	105,334			
Herring oil ... tuns.	11	1,188	Total		6,408,785

Vol. VI, No. 2. Washington, D. C. Feb. 8, 1886.

8.—NOTES ON LOBSTER CULTURE.

By RICHARD RATHBUN.

EXPERIMENTS BY THE U. S. FISH COMMISSION IN 1885.

The partial completion, in August last, of the new laboratory building at the marine station of the Fish Commission, at Wood's Holl, Mass., with its convenient system of salt-water piping, permitted the necessary experiments being begun at that time with respect to the artificial hatching of lobsters—a branch of fish culture the great importance of which has long been felt in view of the rapid decrease in abundance of that valuable food product. Unfortunately the hatching season had then closed, but it was deemed advisable to ascertain the best methods of handling the eggs, in order that there might be as little delay as possible in starting operations next spring.

Unlike most fishes, the lobster carries its eggs until they hatch. The eggs are fertilized while yet in the ovaries, and are soon afterward extruded, but the length of the period of development is not known. As they issue from the body of the female, they are coated with a viscid substance that soon hardens into short, tough, and very flexible threads, by means of which they are attached in bunches or clusters, of variable sizes, to the swimmerets and under surface of the abdomen or tail, the hinder feet, it is said, being used to aid in carrying them back and distributing them as they come from the apertures of the oviducts. The eggs are comparatively large (about one-twelfth of an inch in diameter) and hardy, and each lobster carries from about 12,000 to 24,000, according to its size.

The problem of lobster hatching on a practical scale is one that the Fish Commission has long had in view, but all of its marine laboratories up to the present time have been temporary structures, with insufficient accommodations and without the means of obtaining continuous supplies of water in suitable quantities. It was hoped that the new building would be finished early enough in the spring to permit of the beginning of hatching work in June; but the hinderances which are inevitable to all such projects interfered to delay actual operations for another year. The hatching of small quantities of lobster eggs, as well as the eggs of other species of crustaceans, had been successfully accomplished, from time to time, by members of the Fish Commission party interested in embryological studies, and the possibility of conducting hatching operations on a small scale, and of carrying the young through at least the first few stages of growth, needed no further proof; but the

question of how to care for large masses of eggs, and especially for the young after hatching, was yet to be approached.

In the fall of 1884, soon after the inner fish basin at Wood's Holl had been completed, Capt. H. C. Chester, in charge of the station, transferred to it several hundred female lobsters with spawn, thinking that some of the eggs might hatch during the winter, but, if not, feeling certain that something might be done with them in the early spring. Unfortunately for his experiment, the work on the outer basins necessitating the employment of a large steam dredger, which kept the water constantly loaded with sediment, and the frequent blasting of rocks, caused the destruction of his entire stock before any results had been reached. The method of continuing the work in the summer had not yet been decided upon, when an opportune letter, received from the Norwegian fish-culturist, G. M. Dannevig, announced the successful hatching of lobster eggs of the European species, detached from the body of the parent, and the rearing of the young through the three earliest stages. The manner of conducting his experiments was not described, but the fact that he had accomplished good results with detached eggs gave us a basis to work upon. His letter was as follows:

FLODEVIG, near ARENDAL, NORWAY, *July* 14, 1885.

DEAR SIR: I hereby take great pleasure in informing you that the experiments with the hatching of detached lobster eggs is progressing very favorably, that the young are doing well, and that some of them have attained what Prof. G. O. Sars calls the third stage.

The length of the young lobster soon after hatching is about 9^{mm}. After 8 days, when the second changing of the shell or skin takes place, it has attained the length of 12^{mm}, and after 16 days, when the third change occurs, it is about 15^{mm}. The mortality was rather large for some days, but is now only 1 to 3 in 24 hours, so that 95 still remain out of 200 which were picked out for an experiment. They are very greedy, but not so bad in killing one another as they were in the beginning. I feed them principally with the soft parts of our crab. They like it well, but their slender legs sometimes get entangled in the soft mass, and then they die. Five hundred newly-hatched individuals are now in a separate apparatus for further experiments. I wish to find out at what stage the greatest loss takes place. I have great hopes now that I shall master this question during the season, so that I can proceed upon a large scale next summer.

Very respectfully,

G. M. DANNEVIG.*

Prof. SPENCER F. BAIRD,

Commissioner of Fish and Fisheries, Washington, D. C.

* For a later account of this experiment, see letter of G. M. Dannevig, in Bull. U. S. Fish Commission, v, p. 446, 1885.

If a few eggs are cut from the swimmerets of a lobster and dropped into a jar of water, they will rapidly sink to the bottom, showing that their specific gravity is considerably greater than that of water. The knowledge of this fact led to the selection of the McDonald automatic hatching-jar, which has long been in use in shad propagation, for the first experiments, and a trial of about two months has demonstrated its superiority for this purpose over the other appliances that were tested. The principle on which the McDonald jar works has already been fully described,* and we need only mention here, for the purpose of showing its adaptability to the eggs in question, that the water entering through a long glass tube, reaching nearly to the bottom of the jar, causes an upward current of water through the jar, the force of which is regulated by the amount of inflow; the outlet is by means of a short tube passing only a little way into the upper part of the jar. The inlet tube is connected by rubber tubing with a supply pipe, and the outlet tube in the same manner with a waste pipe, and these connections being made, the movement of the eggs is entirely controlled by means of a stop-cock and the longer tube, the latter, by being raised or lowered, changing to a certain extent the force and character of the current. The flow is continuous and regular, and the jars need to be examined only occasionally, perhaps twice each day, for the purpose of forcing out the accumulation of sediment, as explained further on.

The eggs are readily cut from the swimmerets and under surface of the lobster by means of small sharp scissors, the curved kind used in dissecting being especially well adapted to this purpose, although most any kind will answer. By taking ordinary precautions no harm is done to the parent, the small threads joining the eggs to the body having no organic connection with it. Most of the eggs come off in bunches of variable sizes, some containing two or three hundred, and others less, down to a very small number, but more or less of them become separated in the cutting, and in every batch there are many free eggs. This lack of uniformity in the composition of each lot of eggs is a source of great annoyance in handling them, the free eggs floating up more readily than the bunches and tending to escape through the outlet pipe, but it is not detrimental to the success of the work. In preparing the eggs, they were transferred as rapidly as detached to the hatching-jars, previously filled with water, the eggs of each lobster being placed in a separate jar, as there is more or less variation in the specific gravity of the eggs of different individuals.

As soon as each jar had received its allotment, the cap with its tubes was fastened on, and a connection made with the salt water supply pipe. The specific gravity of the eggs was not determined, but they require a relatively strong current of water to raise them above the bottom, the average amount allowed to pass through the jars having been nearly a gallon a minute for each. The flow was so regulated as to give the

* Bull. U. S. Fish Commission, iii, pp. 183-192, 1883.

larger bunches of eggs a gentle rotary motion; but this caused the smaller bunches and the free eggs to rise sometimes to more than half the height of the jar and kept them quite strongly agitated. Although the eggs are very hardy, and in nature, while attached to the swimmerets of the parent lobster, are given but little motion, this greater activity appears to be essential to their well-being in the artificial hatching apparatus, for without it they soon die. Such a fate befell most of one lot contained in a McDonald jar, through which but a gentle current was allowed to pass, and in one of the hatching-boxes, where the supply of water was very much greater, though distributed over a much larger surface, so that no motion was given to the eggs, they all died inside of a week. The accumulation about the eggs of impurities from the water may have been the principal cause of this mortality; but as the eggs are well able to endure active motion and thrive best in a strong current, there can be no objection to pursuing that method. An illustration of the hardy character of the eggs is furnished by the fact that a small quantity left over night in a watch glass of sea water were alive and apparently in good condition in the morning, although the density of the water had been greatly increased by evaporation.

The chief annoyances to hatching work at the Wood's Holl station this summer were, first, iron rust, and, second, sediment from the harbor. The supply mains in use when the laboratory was first opened consisted of iron pipes without a protective lining; they had been down a year, and gave off such a large quantity of rust, which often appeared as a dense reddish cloud of exceedingly fine suspended particles, that the hatching-jars would become strongly stained inside of a few hours and the eggs themselves become perceptibly coated. After the cement-lined pipes had been substituted, this trouble ceased for the most part, but a great deal of sediment was observed in the sea water the remainder of the season, and notwithstanding the strong current passing constantly through the jars, a very perceptible deposit was formed over the lower-lying eggs in the course of every twelve hours. The lighter particles of sediment also collected to a large extent on the sides of the jars and tubing, and often adhered to the more buoyant eggs. Cloth filters were used to strain out these impurities, but they proved unsatisfactory, and the course finally pursued was to force out the sediment every morning and evening by momentarily increasing the flow of water to its utmost capacity, and then shutting it off, repeating this operation at frequent intervals for several minutes. The effect was thoroughly to stir up the sediment, which, being lighter than the eggs, remained longer in suspension and was carried off when the flow was again made normal. The eggs were transferred to clean jars every four or five days, and the old jars thoroughly washed.

By constant attention to all these details, the eggs were kept in a healthy and tolerably clean condition as long as the experiments were kept up. A neglect of these precautions always resulted in the de-

struction of many eggs, although in the first lot of eggs prepared, which suffered greatly from iron rust, and was frequently left without care, sometimes for days at a time, until they were well covered with sediment, fully one-third were living at the end of eight weeks, when I left the Wood's Holl station.

It does not seem practicable to keep the eggs of more than one lobster in each jar, as the eggs of different individuals differ more or less in specific gravity, and it is impossible to regulate the flow of water so as to give them all the required motion; but as the number is considerable in each, there is not sufficient excuse for attempting economy in that direction. The number of fertilized eggs carried by lobsters during the spawning season has been ascertained by careful computations in several cases, and varies from about 12,000 to 24,000, the latter number probably being rare. The most common number noticed during late years has been from 15,000 to 18,000.

The question of the amount of motion to which the eggs should be subjected is one deserving much consideration. The females with eggs contained in the aquaria at Wood's Holl remained very quiet most of the time, and the swimmerets and eggs were scarcely ever observed to be in motion. Confined within the narrow limits of an aquarium, with a strong light entering from all sides, it was not to be expected that their movements would be altogether natural. In nature, whether or not their swimmerets are kept moving regularly backwards and forwards, which is probably the case to a greater or less extent, the act of moving about in search of food or for change of ground must bring a constant change of water. With the Clark hatching-boxes, which are very successful for certain kinds of fish eggs, no good results were obtained, although the flow of water was much greater than in the McDonald jars. These boxes were tried in two ways, with a downward and an upward flow of water, but the eggs remained perfectly motionless, and at the end of a week were in such bad condition that they had to be thrown away.

The experiments above described merely indicate a method by which lobster eggs detached from the parent may be successfully kept alive for a considerable length of time with sufficient economy to commend the process to future practice. Had the experiments been made during the hatching season, more satisfactory results would undoubtedly have been reached. It is not expected that in actual practice the eggs will have to be kept very long in the jars. The extensive storage basins in front of the laboratory will afford accommodations for large quantities of "berried" females, which can be so arranged as to permit of their being readily examined from time to time and the condition of the eggs observed. As the eggs approach the last stages of development before hatching—a condition that is easily determined almost by the unaided eye—they can be transferred to the hatching-jars, and the final changes allowed to take place under constant observation. As the hatching is

limited to a period of about two months, it is probable that the eggs of many individuals reach maturity at about the same time, and a large number of jars can be manipulated together.

The principal object in hatching the eggs in jars is to have the embryos under control immediately after hatching; but the best methods of caring for the young have yet to be decided upon, and furnish an interesting problem for investigation next spring. It is probable that the embryos cannot be kept in the McDonald jar, as they swim at the surface and would soon all escape through the outlet tube. They can, however, be transferred to large aquaria, to the large wooden tanks now rigged on the lower floor for the keeping of fish, or to floating cars in one of the basins. The last plan will probably answer best when working on a large scale, as the embryos will thereby obtain some food from the surrounding waters, while in both of the former cases food would have to be supplied them.

A floating car suitable for the purpose has already been constructed, and now contains a number of berried lobsters, which it is proposed to keep over winter, if possible, in order to observe whether any hatching takes place during that season. This car is constructed on the plan of the ordinary fish cars, the openings being covered with a fine-mesh brass-wire cloth to prevent the escape of the young, but with the meshes large enough to permit of the entrance of such small life as the embryos would be likely to feed upon at the surface. The dimensions of this car are 5 feet long, 3 feet wide, and 2 feet deep, but larger cars will be used if necessary. It is now moored in the outer basin, opposite one of the openings in the wall, where it receives the full force of the current. A few McDonald jars will also be kept in operation, with lobster eggs, during the entire winter, for purposes of observation.

It is not known how long the young can be kept in confinement, nor at what age it would be advisable to turn them over to the care of nature, but it will probably be possible to transport them alive to any other portion of the eastern coast, as the distances are nowhere great.

NOTE.—Since the above was written, a letter has been received from Capt. H. C. Chester, superintendent of the Wood's Holl station, giving an account of the hatching of a few lobster eggs in one of the McDonald jars early in November. The eggs were detached from the lobster and placed in the jar November 5; they began to hatch November 8, three days afterwards, and continued hatching for a few days longer, but only about 50 young ones were observed. The remainder of the eggs are still in the jar, in good condition. A few of the embryos were transferred to an aquarium with running water, and others to a small vessel in which there was no change of water. The former lived about 20 hours, the latter about 36 hours. The temperature of the water in the hatching-jar November 5 was 54.3° Fahrenheit; on the 6th, 55°; and on the 7th and 8th, 56°.

NECESSITY OF ATTEMPTING THE ARTIFICIAL PROPAGATION OF LOBSTERS.

In a report to the U. S. Commissioner of Fish and Fisheries, on the lobster fishery of the United States, now in course of publication, the writer has given an account of what is known regarding the habits and abundance of both the American and European species, which differ but slightly from each other structurally. The investigations on which that report is based confirmed the fact, previously well known to those acquainted with the industry, that the abundance of lobsters, as well as their average size, has been rapidly decreasing from year to year on many portions of the coast, ever since the fishery has been vigorously pushed. A study of the habits of lobsters indicates that such a decrease is far more possible with that species than with the true fishes, which are, as a rule, more secure from the attacks of man.

That a decrease has taken place, and that in some regions it has amounted to a serious loss, is attested by the statements of numerous fishermen and dealers, which are quoted at some length in the report above mentioned.

All the States interested in the lobster fishery, excepting New Jersey, whose fishery is small, have enacted protective laws; but, either because these laws are inadequate or are not properly enforced, they have failed to stop the decrease, though they may have checked it more or less. As a result, the fishery is falling off in the United States, and we are even now dependent, to a greater or less extent, on the British Provinces for the supplies of our larger markets. The same trouble exists in Europe, where the lobster fishery is, of course, of much older date than in this country, and where it has been controlled by legislation for many years. Many elaborate reports have been published upon the European fishery by experts appointed to investigate its condition and needs, but they are apparently at as much loss there as we are here regarding the methods and benefits of protection. In Norway, which country possesses the most important European fishery, they have, as a last resort, sought relief through the aid of artificial lobster culture, and experiments to that end have been carried on for several years. In the United States, where the methods of fish culture are best understood and have been most productive of beneficial results, it is natural to suppose that the same course would have been often suggested, and such has really been the case. None of the trials up to this year have, however, been made according to the most approved methods of fish propagation, and insufficient means for carrying on any such practical experiments with respect to salt-water species of fish have alone prevented the Fish Commission from engaging in this work before.

It would be impossible, within the limits of this paper, to cite even a portion of the evidence bearing upon the decrease of lobsters which has

been collected, but following are a few of the remarks with which this subject is introduced in the report already referred to:

"An illustration of the rapidity with which the lobsters of a small area may be caught up, is furnished by a salt-water inlet on the coast of Maine, in which lobsters were at one time very abundant. This basin opens directly into the sea, and is sufficiently large to have afforded a remunerative fishery to several lobstermen. Two years' time was sufficient to reduce the supply of lobsters to such an extent that fishing became unprofitable. After an interval of about five years they again became abundant, and the supply was once more exhausted. Had this inlet not been so situated that it readily received supplies from without, it is probable that it would have required a much longer time to become replenished.

"On a much larger scale has been the depletion of the once noted grounds about Cape Cod, Massachusetts, which at one time furnished nearly all the lobsters consumed in New York City. In the early part of the century, this fishery was entirely in the hands of fishermen from other States, principally Connecticut, who came to Cape Cod with their smacks, and, after catching a load, carried it to New York or Boston. As early as 1812 the citizens of Provincetown realized the danger of exhausting the grounds about their town, and succeeded in having a protective law passed by the State legislature. More or less stringent regulations respecting the lobster fishery of Cape Cod have been in force from that time down to date, and they have probably done good service in prolonging the fishery; but the period of its prosperity has long since passed, as continued overfishing has so exhausted the grounds on almost every portion of Cape Cod that they are no longer profitable even to the few men who still set their traps there. From the sketch of this region, given further on, it will be seen that the decrease has not been a temporary one, although an entire rest for a long period of time might possibly allow it to recover more or less of its former abundant supplies. As it is, no large catches are now made, and but few lobsters are carried away from the Cape.

"The immediate vicinity of Provincetown has suffered most in this respect, but scarcely more than any portion of the coast from that town to Boston on the one side and to New Bedford on the other. A delay in the publication of this report enables the writer to add a note for the southern portion of this region, covering the period down to July, 1885. Vineyard Sound proper and the vicinity of Wood's Holl, Mass., have afforded but poor catches for a number of years, but the region about Gay Head has continued to attract the lobstermen down to the present time. Each succeeding year, however, lobsters have appeared to be less plentiful, and during the spring months and June of 1885 scarcely anything has been done. The fishermen are discouraged, and are forced to attribute the scarcity to overfishing, the possibility of which many of them have all along denied. At Cuttyhunk Island the catch for

1885 was less than one-fourth that for 1880, and the same was reported of the remainder of the Elizabeth Islands, No Man's Land, and Gay Head.

"In the waters of Rhode Island and Connecticut a large decrease of lobsters is reported by many of the fishermen, and the increased catch for the few years preceding 1880 was obtained only by the use of a much larger number of traps than was employed formerly. Although the fishery in those States was begun very many years ago, it is only within comparatively recent times that it has been extensively carried on.

"On the coast of Maine the evidences of decrease are very strong, especially as regards the shallower areas, but the rapid extension of the grounds into comparatively deep water has made the actual decrease less apparent. The rocky bottoms of the coast of Maine are also supposed to afford the lobsters greater protection than the sandy ones to the south, and in many places the traps cannot be set as closely together, nor is it probable that the lobsters in such localities move about as much in search of food.

"The greatest decrease has occurred within the past 15 to 20 years, or since the establishment of numerous canneries and of the perfected methods of transporting fresh lobsters to all parts of the country. The demand being so much greater than the supply, there are no restrictions on the amount of the catch beyond those imposed by the State laws or resulting from the scarcity of lobsters. Fish are among the greatest enemies of the lobster, and cod are known to consume enormous quantities; but nature has provided against their extinction by such means, and it is man alone who has disturbed the balance."

The above remarks were based mainly upon the fishery investigations of 1880, since which evidences of continued decrease have been constantly received. About a year ago, a prominent Boston dealer wrote that he was receiving large quantities of lobsters from Nova Scotia, as the Maine fishery was totally inadequate to supply the demand, the amount obtained from that State having been less than in previous years.

One of the strongest evidences of decrease in abundance is afforded by the continuous decrease in the average size of the lobsters sent to the markets. The exact amount of this decrease is not determinable, as no records bearing upon this subject were made prior to 1880, but the fact was granted by the fishermen and canners, even in those regions where a perceptible decrease in numbers was not admitted. The average weight of the lobsters marketed in most places in 1880 was estimated to be about two pounds each. A New Haven correspondent stated that the average length of the lobster sold in the markets in that place in 1880 was about 10½ inches, and the average weight about two pounds, against an average length of about 13 inches and an average weight of about three and one-half pounds 20 years ago. In Boston the market lobsters ranged but little above the limit in size permitted

by the State laws, and that seems to be the case nearly everywhere. In Portland, Me., the average length of the lobsters marketed in 1880 was about 10½ inches, and in Boston 11 to 11½ inches, while in New York City the range in size was from 10½ to 15 inches.

The facts above stated apply only to the larger distributing centers, where custom had prescribed the minimum limit in size of the lobsters marketed, before protective laws were enacted. At that time there was an abundance of large lobsters, and the smaller individuals were regarded as of little account for the fresh trade. They have, however, been used for a long time by the canneries on the coast of Maine, by the fishermen as bait, and to supply local demands. The quantity of lobsters consumed, measuring less than 10 inches in length, is, therefore, very great, and on some portions of the Maine coast the canneries make use of only those that are too small for the fresh-market trade. In fact, the greater proportion of the lobsters now canned are less than 10 inches long. From these statements it will be seen that there is a steady demand for lobsters of all sizes, and that but a limited protection is afforded either by laws or custom.

RANGE AND MIGRATIONS OF LOBSTERS.

The American lobster has been taken as far south as off Cape Hatteras, N. C., where a single medium-sized individual (13 inches long) was dredged from a depth of 49 fathoms, by the Fish Commission steamer Albatross, in 1884. Two or three examples have also been recorded from the northeastern part of the sea-coast of Virginia, but the Delaware Breakwater may be regarded as practically the southern limit of its range, although it is not at all common at that place, and is rarely fished for. Lobsters are somewhat more abundant off Atlantic City and Long Branch, New Jersey, where they afford a limited fishery, and in New York Bay and the adjacent regions they were at one time quite plentiful, but overfishing and the pollution of the waters have almost entirely exterminated them there. Passing eastward through Long Island Sound, they gradually increase in abundance as we approach the Block Island region, and from there to the extreme northern limit of the coast of Massachusetts, wherever the bottom was suited to them, they were formerly exceedingly abundant. The first important fishery originated along this section of the coast, Cape Cod at one time having furnished New York City with nearly all of its supplies. The sandy shores of New Hampshire are not so prolific in lobsters as are those of either of the adjoining States. Maine is now the principal source of supply for all the larger markets of this country, the yearly fishery of that State greatly exceeding in quantity and value those of all the other States combined.

Most of the British maritime provinces abound in lobsters which are especially plentiful on both the ocean and gulf coasts of New Brunswick and Nova Scotia, these two countries now affording the most ex-

tensive lobster fishery in the world. They appear to be much less common in Newfoundland and Labrador, possibly because they have been less fished for there.

Lobsters are not known to migrate, excepting over very short distances, mainly in the spring and fall, when they change their grounds, moving into deeper water on the approach of cold weather, and returning nearer to the shore in the late spring. The fall migrations are solely for the purpose of escaping the cold of winter, the shallower summer grounds probably furnishing a better supply of food. The extent of the movements depends more or less upon the character of the coast, for where the bottom slopes off very gradually they will need to go a much greater distance to reach a suitable depth of water than where deep holes occur near their summer grounds. The summer fishery is mainly in depths of a very few to 15 or 20 fathoms, the winter fishery in 25 to 60 fathoms. On the coast of Maine the traps are sometimes set in such shallow water that they lie partly exposed at low tide. Formerly some fishing was done along the shores by means of gaffs and dip-nets, but lobsters rarely occur in such favorable localities now.

It is supposed that lobsters do not travel much along the coast, though they probably change their grounds from time to time in search of food. On some portions of the coast the fishermen claim to have good evidence of the schooling of lobsters, and state that the schools appear and disappear suddenly, indicating the possession of certain migratory habits, but there is no proof that their migrations extend far, and they are very different in character from those of the true fishes. We have no evidence to prove that any one region has been directly benefited by large accessions from an adjoining region, and the extent to which some districts have been depleted by overfishing without subsequent recovery indicates that the supplies of one region are but little dependent upon those of another, at least not for immediate relief. The Cape Cod lobster fishery has been at a low standing for many years, and although but few men have engaged in the fishery of that region for a long time, there are, as yet, no signs of improvement.

SPAWNING SEASON AND HABITS, DEVELOPMENT AND RATE OF GROWTH.

Lobsters are found with spawn attached to the abdomen during the entire year. This fact is recorded of both the American and the European species, but the length of time they are carried before hatching and the limits of the hatching season are not precisely known. As regards the European crayfish, a freshwater crustacean closely related to the lobster Professor Huxley states: "The process of development is very slow, as it occupies the whole winter. In late springtime or early summer, the young burst the thin shell of the egg, and, when they are hatched, present a general resemblance to their parents. This is very unlike what takes place in crabs and lobsters, in which the young

leave the egg in a condition very different from the parent, and undergo a remarkable metamorphosis before they attain their proper form."

The smackmen of the southern New England coast claim that the eggs hatch in the wells of their smacks in the greatest abundance, from some time in May until late in July, but that at other seasons they have never seen any embryo lobsters, although the smack trade in lobsters is kept up during nearly the entire year. During the season mentioned, the surface of the water in the wells of the smacks often becomes perfectly alive with the young, and they may be scooped up by the hundreds of thousands. This evidence is tolerably conclusive as to the duration of the principal hatching season, and determines the period when experimental work in artificial propagation can best be undertaken. The fact that a few of the eggs contained in the jars at the Wood's Holl station of the Fish Commission hatched during November of this year indicates, however, that some hatching may take place at other seasons, as the conditions under which the eggs were kept were perfectly normal, the water being of about the same temperature as that of the harbor outside. Hatching is supposed to begin somewhat later farther north.

The writer was, at first, inclined to believe that the hatching continued to a considerable extent through the entire year, basing his conclusions upon the fact that, during the months of August and September last, eggs were found in various stages of development, from the freshly laid and totally opaque ones to others in which the dark greenish yelk sack occupied scarcely more than one-half of the area of the egg, the remainder being transparent and clearly showing the structure of the embryo. Some of these eggs, preserved in the hatching-jars, were carefully examined from day to day, and, although they exhibited a certain amount of progress, development was slow. It finally became evident that the development of the eggs was being retarded by some cause, presumably the lower temperature of the water, and this result, coupled with the statements of the fishermen, that embryos are seen only in May, June, and July, makes it probable that the hatching of lobster eggs at other seasons is only an accidental or occasional occurrence. It is also not at all improbable that the young hatched during cold weather perish soon after they leave the egg, as they did at Wood's Holl in November last.

The hardy character of the lobster eggs, before referred to, favors the idea of a long period of development, and they appear to be well adapted to endure the hardships of a long winter. The rough handling to which they were sometimes subjected, in connection with the experiments of last summer, did not seem to harm them in the least. It is also probable, from this quality of the eggs, that they are not destroyed to any extent, in nature, unless actually eaten from the swimmerets of the parent by predaceous fishes, and that the chief assistance which artificial culture can give, in an attempt to increase the supply, must be directed toward protecting the embryos from the period of hatching.

Embryo lobsters are seldom seen at the surface in the open waters about our coast and have rarely been taken in the towing net. Prof. S. I. Smith, who has studied the younger stages, obtained his specimens during July, mainly in Vineyard Sound, near Wood's Holl, Mass. Nothing positive is known respecting the habits of lobsters during the spawning season. It has been stated with reference to lobsters marketed in Boston, that berried lobsters are seldom seen measuring less than about 10½ inches in length, and it is probable that they rarely begin to spawn before attaining that size. However, a few smaller ones were observed at Wood's Holl during the summer of 1885. In a lot of fifty-two berried lobsters, examined at that place in September, three measured less than 10 inches, the smallest having been 9½ inches long; eight were between 10 and 10½ inches; ten between 10½ and 11 inches; fifteen between 11 and 12 inches; eleven between 12 and 13 inches, and five between 13 and 14 inches. The measurements were made from the tip of the rostrum to the end of the telson, not including the hairs.

The development of the younger stages of lobsters has been studied by Prof. S. I. Smith, for the American species, and by Prof. G. O. Sars, for the European. The eggs, when first emitted, are entirely opaque and of a dark green color, sometimes almost black. Professor Smith examined the well advanced eggs at Wood's Holl, in May. They were not perfectly round, measuring a trifle more than two millimeters (about one-twelfth of an inch) in their longest diameter. One side was still dark, due to the unabsorbed yelk mass, and the other more or less transparent, showing the eyes as two large black spots, and the outlines of the carapax and legs. All of these features are readily made out under a low-power objective. Soon after hatching they measure about one third of an inch in length, and resemble in appearance and structure a low group of shrimps, called the Schizopods, which are common on some portions of our coast. The eyes are bright blue, while portions of the body and its appendages are marked with orange of different intensities, rendering them very conspicuous objects. The swimmerets are not yet developed. In the second stage, which resembles the first, they have increased somewhat in size, and have obtained the rudiments of a portion of the swimmerets. In the third stage they measure about half an inch long, and the shell has become firmer than before. In the next and last stage observed, the embryo is about three-fifths of an inch long; it has lost all of the characters in which it resembles the Schizopods, and has assumed the more important features of the adult. It still retains the free-swimming habit and is very active in its movements, frequently jumping out of the water by means of its caudal appendages. This stage was frequently taken from the 8th to the 20th of July, and Professor Smith thinks that the larva passes through all of these stages in the course of a single season. The stages immediately following the above were not observed.

The young, like the adult lobster and the crabs, increase in size by molting, or casting off the shell covering the body, a new shell rapidly forming in place of the old one. During the first season, as above described, the molts are frequent, and the embryos remain at the surface of the water as free swimmers, but how long the young, after reaching the lobster-like form, retain this free-swimming habit was not ascertained. As the lobsters increase in size, it is evident that molting occurs less frequently, and in the adults probably only once a year.

The rate of growth of lobsters has not been determined, and at present we have no means of telling the age of a lobster measuring 10 inches in length. A few measurements have been made showing the amount of increase at certain molts, but it is not always constant, even for lobsters of the same size, and not knowing the frequency of molting or shedding, we have no way of computing the rate of increase. One lobster measuring 8 inches before shedding was said to measure 10 inches after shedding; another, 10 inches before and 12 inches after shedding; a third, 10½ inches before and 11¾ inches after shedding; a fourth, 10½ inches before and 12 inches after shedding. Ten-inch lobsters are probably at least five or six years old, but such estimates are only the result of guesswork, and may be very far out of the way.

EXPERIMENTS PREVIOUSLY MADE IN LOBSTER CULTURE.

In the United States the only practical attempts that have yet been made toward the artificial propagation of lobsters have been in connection with the so-called "parking" of lobsters—that is to say, their protection in large inclosed natural basins, primarily for the purpose of perfecting them for market, and of retaining conveniently at hand at all seasons a large reserve stock. In these parks the young lobsters taken by the fishermen are allowed to attain the adult size, the soft-shelled individuals to become hardened, and injuries to be repaired. Under such natural conditions, it is reasonable to suppose that the breeding habits would continue normal, and that large quantities of spawn would be hatched; but whether the young would survive and increase in sufficient numbers to render the scheme profitable, if carried on for this purpose alone, has not been determined, though none of the projects had been continued long enough to give satisfactory results, at last accounts. Two such parks in the United States have been specially called to our attention. The first was established on the coast of Massachusetts in 1872, and was afterwards abandoned, though for what reasons we do not know. The second was started in 1879 or 1880, on the coast of Maine, and is, we believe, still in operation.

The latter is a small inclosed bay, with a narrow entrance, through which the passage of all objects above a very small size is prevented by a screen of wire netting. This bay had previously furnished good lobster fishing, and was much resorted to by fishermen. It contains an

abundance of food suitable for lobsters, and toward the center has a sffiucient depth of water, with soft bottom, to afford some protection to the lobsters during the colder part of the year. Into this park large quantities of soft-shelled lobsters, of lobsters minus one or both claws, as well as of young individuals under the legal size of 10 or 10½ inches, have been placed for growth and repair, and it is claimed that the results have been very satisfactory in that particular. At the beginning of cold weather the lobsters retire to the deeper parts of the bay, and at times, when the water has been calm and clear, they have been observed almost completely buried in the mud, with only their feelers, eyes, and a small portion of the front of the carapax exposed. Many of the injured lobsters first placed in the park were females with spawn, and since then berried lobsters have been purposely added from time to time. Young individuals of different sizes were said to have been abundant at last accounts, but in an experiment of this character a considerable lapse of time is required to test its merits. As such parks do not depend for their practical success solely upon the rearing of the young, but rather upon the perfecting of market supplies, which come from the traps in poor condition, it is possible that they may be made to pay if carried on economically. Their effect upon a general increase of supplies would probably never be very great.

So far as we are aware, experiments upon the propagation of lobsters in Europe have been confined mainly to Norway, and were commenced there in 1873. The first report upon this subject was published in 1875. The berried lobsters were kept in boxes, constructed so as to retain the embryos after hatching. The young remained alive for several weeks, and their habits and the causes of their destruction were carefully studied. The results of these experiments will be of great service in the treatment of the young at the Wood's Holl Station next summer. Mr. Dannevig's more recent investigations in the same line have been noticed above.

TRANSPLANTING OF LOBSTERS.

Of great interest in connection with the artificial propagation of lobsters, and bearing upon the same subject, is the question as to whether lobsters can be successfully transplanted from one region to another. This experiment has already been tried two or three times, but so far without success. The transportation of live lobsters long distances, even by railroads, has been accomplished, and they have also been carried from this country to England. Mr. Livingston Stone made three attempts to introduce the East Coast lobster on the coast of California, and on the last trial succeeded in planting a number of living individuals near the mouth of San Francisco Bay. As full accounts of these experiments have already been published by the Fish Commission,* we do not need to repeat them here.

*Report U. S. Com. of Fish and Fisheries, Part III, pp. 259–265, 1873–'75 (1876); Part VII, pp. 637–644, 1879 (1882).

The successful transplanting of lobsters must depend upon the new region affording conditions sufficiently like those of the old to favor the growth and reproduction of the species; but the relative conditions of different regions have never been carefully studied with this object in view, and we are to-day unable to state precisely in what manner the Pacific coast waters agree with, or differ from, those of the Atlantic coast. Neither the temperatures nor the specific gravity of the waters of the two coasts have been compared, and it is only through incidental experiments that the fact has been ascertained that a few species from each coast are able to live and thrive upon the other. The conditions that are essential to, or control the existence of a species in a new region undoubtedly vary more or less according to its organization, and the effects of changes of location upon the higher crustacea have been but little studied, if at all. Above all the new-comer must have the power to sustain itself in the struggle for existence with those forms which already occupy the ground, and have been accustomed to it from long habit. Careful studies and experiments in this line of research, with reference to marine forms, would be of great practical benefit to the aims of the Fish Commission, and would probably lead to the transplanting of many kinds of marine products to regions which are now poorly supplied with edible forms.

A sort of transplanting of young lobsters has been going on along the New England coast, and especially the southern portion of it, ever since the well-smack lobster trade began. The fact was mentioned above that immense quantities of embryo lobsters appear at the surface of the wells in the carrier smacks during the hatching season, and as the smacks journey along they work out through the holes in the bottom of the well, and are thus constantly adding to the supply of the regions through which the smacks pass. It is unquestionable that the abundance of lobsters on the southern New England coast has been partly kept up, and probably increased at times in the past, by this transplanting of the young, and this fact was noticed and referred to over thirty years ago. The fishermen have the greatest respect for the embryo lobsters that appear in the wells of their smacks, and take great pains that no harm shall come to them.

Numerous accounts have appeared in the newspapers, from time to time, since this transplanting occurred, to the effect that many young lobsters, supposed to be the progeny of those brought over by Mr. Stone, had been taken by the fishermen in the vicinity of San Francisco. Careful investigation, however, has failed to substantiate these reports, and the few small lobsters, so-called, that have been referred to naturalists, have proved to belong to another related genus, quite common on the California coast, but the species of which never grow to a length of more than 3 or 4 inches.

WASHINGTON, D. C., *December* 16, 1885.

Vol. VI, No. 3. Washington, D. C. Feb. 18, 1886.

9.—NEW ENGLAND FISHERIES IN SEPTEMBER, 1885.

By W. A. WILCOX.

September is the beginning of the end of the season's work; and the Grand Banks, Greenland, and Iceland fishing vessels have most of them returned, but the mackerel fleet will remain out a few weeks longer. By the close of the month most of the small boats engaged in shore fishing off the coast of Maine will have hauled up.

During the past month the receipts of fish at Gloucester, as compared with those of the corresponding month last year, show a gain of 649,500 pounds of halibut; a falling off of 353,000 pounds of codfish, 69,462 pounds of other ground-fish, and 51,157 barrels of mackerel.

The catch of codfish, for the number of vessels engaged, has been an average one. The Grand Banks fleet returned with full fares. A less number of vessels having been engaged accounts for the decrease in the aggregate receipts. The mackerel fishery, which gave promise of a large catch, shows a heavy falling off from August, as well as from the corresponding month of last year. During the entire month the body of mackerel appeared to be near shore around the rocks, making it almost impossible to take them with seines, with which the catch is exclusively made. The shore fleets, numbering from 250 to 300 sail, have followed the fish from the Bay of Fundy to Cape Ann, in nearly all cases finding the fish near the rocks and shore. Every day seines were badly torn and damaged, while the catch, if any, was light, disappointing, and in most cases unprofitable.

During the month from 12 to 15 vessels have remained in the Gulf of St. Lawrence, occasionally finding fish abundant, and at other times not finding any. A fair catch, however, was made during the month.

Swordfish have been more abundant than for years, the catch being mostly taken in the Bay of Fundy and marketed at Boston.

Alewives (glut herring) have continued remarkably abundant all along the eastern coast, and mackerel seines have often been filled with them, and the fish released. The only attempts to save these fish have been by the small steamers and vessels engaged particularly in this catch, selling the fish to the oil factories at Boothbay. Steamer Mabel Bird, of Portland, reports having taken 3,000 barrels.

Shore herring arrived earlier than usual, were of large size, fine quality, and for a few days very plentiful. On September 22d and 23d, 1,800 barrels were taken in nets set in Gloucester harbor. A storm on the 24th badly damaged the nets and drove the fish out. Along the eastern

coast, off Wood Island, and other localities in Maine, herring were reported abundant, but owing to fewer vessels having been engaged, the catch was much under the average.

GREENLAND AND ICELAND HALIBUT FLEET.

During the past month most of the vessels from the United States engaged in this far-away fishery have returned. With one exception they belong to Gloucester. The following is the list of vessels (all schooners), with dates of sailing and return:

Greenland.			Iceland.		
Name.	Sailed.	Returned.	Name.	Sailed.	Returned.
Druid	Apr. 18	Sept. 21	Alice M. Williams†	Apr. 21	....
Lydia Y. Crowell*	June 16	Sept. —	Carrier Dove	May 15	Sept. 10
Mary E	Apr. 14	Oct. 15	David A. Story	Apr. 20	Sept. 6
Mist	June 16	Sept. 23	Lizzie H. Haskell	Apr. 21	Sept. 20
Seth Stockbridge	Apr. 22	Sept. 21	Marguerite	Apr. 28	Sept. 23

* Of Beverly, Mass. † Lost.

None of the vessels made full fares. Off Greenland the weather was reported good and fish scarce, while off Iceland fish were more abundant, but stormy weather prevailed much of the time. Capt. John Cousins, of the Carrier Dove, reports as follows: Sailed from Gloucester on May 15; arrived off Iceland June 23; left August 9; arrived at Gloucester, September 10. On arriving at the fishing grounds found the coast entirely surrounded by ice at the northern part of the island, where all the fishing was done. No halibut being reported on the southern coast, we had to wait about a week for the drift ice to clear. After that, ice was reported outside of the fishing grounds, but occasioned no trouble. Fished entirely with trawls set from 20 to 40 miles from the shore. Fished only for halibut, which appeared to be in spots. The catch was variable, some days only a few being taken, and other days a fair catch was made. We were obliged to change our location every day, having apparently caught all that were on a particular spot. During most of the fishing the weather was very blustery, with strong easterly wind much of the time. About 150 sail, mostly topsail schooners, from France, Norway, and England, were hand-line fishing for cod off the coast. Most of the foreign vessels were from France. The catch was mostly cod, with a small amount of cusk, haddock, and ling. The vessels from the United States fished for halibut only. These halibut average 100 pounds each; near shore they run of small size, some not over a pound. Sharks were very plentiful, and catching them for their oil was made a business by the natives. No fishing, except by natives, is permitted within three miles of shore, a Government steamer keeping watch along the coast to see that the vessels comply with the law.

From the log-book of the Marguerite and the report of Capt. Charles B. Johnson the following account is taken:

Sailed from Gloucester April 28; arrived May 22; sailed for Greenland, to complete the voyage, July 17; arrived there July 27; sailed August 27; and arrived at Gloucester September 23.

On May 9, met drift ice and numerous bergs in latitude 48° 7′ north, longitude 48° 8′ west.

May 10, saw heavy field ice in latitude 49° 29′, longitude 48° 29′.

May 11, no drift ice but many bergs, most of them aground; latitude 46° 28′, longitude 48° 8′.

May 12, two bergs were seen in latitude 47° 26′, longitude 45° 31′.

May 13, clear water; temperature of water, 52°; of the air, 59°.

May 20, an immense berg was seen aground; ran alongside, and sounded, finding 250 fathoms. Measured the berg and found it 610 feet out of water, or total from top to bottom, 2,110 feet; measured nothing but the height, but estimated it at three-fourths of a mile wide, and from 1½ to 2 miles long; water alongside of the berg, 43°; air, 45°; latitude 63° 50′, longitude 26° 46′.

Captain Johnson reports much of the time during his stop that the weather was very unfavorable for fishing. No fish were to be caught within 3 miles of shore, a Danish cruiser keeping watch to see that the law was not violated. No fishing license is required or any charges, except the port charges, which vary according to the tonnage of the vessel. On the Marguerite, of 103 tons, the lighthouse charge of 30 crowns [about $8] was collected once. For the first three times a vessel enters a port, 5 crowns harbor tax is collected each time. After paying three times a vessel can enter as often as they please free of any charge. These are the only charges made by the Government. The storage and temporary care of salt and other goods left on shore is collected by private parties, and it often amounts to a considerable sum, and has given rise to reports that excessive fees were collected for the privilege of fishing. Reports have also been made that much objection was offered to landing and that in some cases a decided refusal was made, both at Greenland and Iceland. Captain Johnson reports no trouble whatever, and nothing but kind and pleasant treatment from the officers at both places. Salt can be bought cheaper at Iceland than here. The halibut and cod-fishing grounds are located at the northern and eastern part of the island; halibut were taken on trawls set in from 30 to 90 fathoms; average weight of halibut, 100 pounds.

Between Iceland and Greenland clear water was found all the way. On July 22 met field ice to the southward of Cape Farewell. When off that cape found a narrow channel; passed into and through it for 180 miles, it being from 1 to 10 miles wide. This took them around Cape Farewell and off Cape Desolation. On July 24 passed in full sight of and within one mile of Cape Farewell. With the exception of a few bergs, the harbor was free of ice.

For a number of years large-sized mackerel, that would inspect as No. 1, have been scarce both in American and Provincial waters. The catch of this season will inspect mostly as No. 2, a very small proportion of large-sized or No. 1 fish being taken. Some years large-sized mackerel have been found in immense numbers early in the season before passing Long Island Sound, after which only a small proportion of large fish were seen during the entire season. Where the large mackerel went to has been a mystery, and a subject of much conjecture. If this question is not partially solved, it is certainly of much interest, and may lead to valuable results in the near future to know that during this season large bodies of extra-large mackerel were seen off the Labrador coast. Captain Johnson, of the Marguerite, reports that on September 5 and 6, Temple Bay, at the northern end of the Strait of Belle Isle, was full of large-sized mackerel. They were also found abundant as far north as St. Lewis Sound, longitude 55° 45′, latitude 52° 30′. At these points the native fishermen were seining codfish, and would take large quantities of mackerel in their nets, but would not save them. The natives reported that for several years, of late, during August and September, mackerel have been plentiful. No small mackerel, or any, except large fish, were seen in that section. This season, at the date mentioned, the fish were fat. Captain Johnson says that those which he saw would more than reach across a barrel, not over one hundred fish being required to fill a packed barrel. Vessels that were trading along the coast packed a few barrels.

Capt. Valentine Doane, of Harwichport, Mass., being on a business trip along the Newfoundland and Labrador coasts, writes, under date of July 28, that mackerel of large size were abundant at Chateau Harbor, Labrador. As the letter has much of interest in connection with the fisheries of that section, some extracts from it are here given:

LABRADOR AND NEWFOUNDLAND FISHERIES.—There are several other harbors near by—Henly, Antelope, Granville, Pitts Arm, &c.—all small, but each with its own peculiar features, and all with the one business and the sole and only thought—fishing. The men catch the fish, the women dress and cure them. The homes of these people are miserable huts and shanties, and yet all are happy and contented, and apparently without a thought of ever having anything better or that there is anything better in the world. I should judge by observation, after visiting all the inlets and coves hereabouts, that there might be 300 persons about here now. It is the most desolate and forlorn looking land I ever saw. The people are sober, honest, industrious, moral, tidy in their appearance, and keep the Sabbath in the strictest sense. We are waited upon regularly by boats that bring us fresh salmon, cod, herring (equal to our No. 1 mackerel), trout, and I have had, to my surprise, twenty-five or thirty fresh mackerel. We also find good clams here, and I am surprised to see the natives stare at us as we dig clams. They never use them, even for bait, and mackerel they not only will

not eat, but will not save them. They find them in their nets among the herring, and until I came and promised to buy them, they would not save one. Now they all understand that I will buy them, and I hope to pick up a few barrels of nice ones. One boat's crew came in yesterday and reported a large school of mackerel in one of the coves on the outside; but there are no seines here that will answer for taking mackerel, and so nothing was done about it. I think there will be one mackerel seine and boat here another year, though they tell us that there have been no mackerel seen about here before for several years, and that they cannot be relied upon. But I am satisfied that there are good mackerel about here now. I found at St. John's, Newfoundland, that the reports from all sources about the island regarding the fish crop for the present season were very discouraging. One of the largest dealers told me he could see nothing but starvation in prospect for many of the outports. He said they exported from St. John's alone last year 1,000,000 quintals of dry cod, and that the crop last year was only two-thirds of a catch, and he feared this year's crop would fall far below that; and the dealers were all very gloomy. And in passing along the coast from St. John's to this place on the steamer we called at nineteen different harbors, and on the Labrador coast at six harbors, and with only one exception they all reported *no fish.* "The poorest fishing ever known in this harbor," was the universal complaint, and certainly they looked as if they were telling the truth, for there was hardly anything about the stages or flakes to indicate what they were used for. We took on at one harbor 125 tierces of salmon and at another 450 cases (four dozen each) of canned lobsters, and should judge that the catch of salmon and lobsters all along the coast had been fair, but I am told that it is never large. The herring have also been very scarce and smaller than usual in size, but at this point, and within 6 miles of this, there has been a good, fair catch of herring within a few days, size large and quality excellent, better to eat fresh than mackerel at this season of the year. I have spoken so far only of the boat-fishing. That is what they call their shore-fishing. There are probably 1,000 sail of vessels owned in Newfoundland and Labrador, principally on the east and the west coast of Newfoundland, that are engaged exclusively in the cod fishery, and from June 15 to October 15 their fishing ground is along the coast of Labrador. From this fleet there have been as yet no reliable reports; only rumors. But in every harbor we stopped at there was a "rumor from the fleet up the coast that they were doing very poorly," and I have heard here within a day or two that up to July 15 the fleet had done but very little; and as all agree that the best of the season is gone when August begins, it looks very gloomy for the cod fishing of Newfoundland. In addition to the boats used about the shore for cod fishing, I find in general use the Yankee invention, traps and seines, and most of the fish taken this season have been taken in seines, regular purse-seines, though not near so large as our mackerel seines, and they

handle them very skilfully. I also notice that as far as I have seen in Labrador the fishing boats are in most cases American build, "lapstreak," handsome, able boats, and the men are proud of them.

During January, February, and March last, three cargoes of codfish were exported from Provincetown, Mass., to Portugal, but owing to to the very high duty ($2.50 a quintal) the shipment did not realize much, if any, more than if sold in the home markets. Yet, from these shipments a number of interesting results have grown. The crews of the three vessels mentioned were Portuguese fishermen that had long fished on the Grand Banks in vessels from Provincetown. On arriving at Lisbon, and speaking of the work, catch, &c., of the American fishing vessels, some persons became interested, engaging as many of the crew as they could to go in vessels for them and show them the Yankee way of fishing. An agent was sent over and four vessels were purchased, one each from Plymouth and Wellfleet and two from Provincetown, and fitted for the Grand Banks, the crew being Portuguese fishermen of Provincetown. These four vessels secured full fares of codfish, which were taken direct to Lisbon, the crew receiving $400 each and their passage back to the United States by steamer. Vessels that were fitted at Portugal, and manned by men from there, are reported as returning with no more than half fares. Lately an agent has been sent to Massachusetts to engage crews for next season; boats (dories) have been ordered from Salisbury, Mass., and a number of vessels from Lisbon will early in the spring come to Massachusetts for supplies and men, going from here to the Grand Banks, thence to Portugal. It is expected that a large portion, if not all, of the Portuguese fishermen of Provincetown will engage in these vessels from their old country. This demonstrates the superiority of New England methods of fishing over those of the Old World.

Receipts of fish at Gloucester, Mass., in September, 1885.

From—	Fares.	Codfish.	Halibut.	Hake.	Pollock.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
George's Bank	148	3,207,000	162,200		
Brown's Bank	1	70,000	300		
Grand Banks	34	1,015,000	1,028,500		
Grand Banks*	7	2,020,000	24,000		
Grand Banks†	1		20,000		
Nova Scotia, Cape Shore	11	483,000			
New England shore	129	20,000		41,000	47,000
Greenland, Flemish Cap	3	130,000	340,000		
Iceland	4		582,000		
La Have Bank	8		218,000		
Bay of Fundy	1	7,000			
North Bay, by railroad	3				
North Bay, by steamer to Boston	3				
Total	353	6,952,000	2,375,000	41,000	47,000

Receipts of fish at Gloucester, Mass., September, 1885—Continued.

From—	Swordfish.	Herring.	Mackerel.	Halibut fins.	Oil.
	Pounds.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
George's Bank					
Brown's Bank					
Grand Banks					
Grand Banks*					
Grand Banks†					
Nova Scotia, Cape shore					
New England shore	12,600	600	24,643		20
Greenland, Flemish Cap				122	
Iceland				107	
La Have Bank					
Bay of Fundy					
Harbor nets		2,535			
North Bay, by railroad			1,227		
North Bay, by steamer to Boston			710		
Total	12,600	3,135	26,580	229	20

Other receipts: dry fish from Maine, 1,650 quintals hake; 400 quintals cod; 450 quintals haddock.
*Subject to duty, from British vessels.
†Fresh fish, duty free, from British vessels.

Location of the New England fishing fleet during the last week of September.—325 sail, mackerel, between Cape Cod and Portland, Me. 25 sail, mackerel, off Nova Scotia and in Gulf of St. Lawrence. 35 sail, halibut, on the Grand Banks, in latitude 44° to 44° 12′, longitude 49° 12′ to 49° 25′. 50 sail, codfish, on the Grand Banks. 140 sail, codfish, on George's and Brown's banks, in latitude 41° to 43°, longitude 65° 30′ to 69°. 5 sail, codfish, off Nova Scotia. 175 sail, ground-fishing, off New England coast. 50 sail, herring, off New England coast.

10.—NEW ENGLAND FISHERIES IN OCTOBER, 1885.

By W. A. WILCOX.

October 3, the month opened with strong NE. winds; to-day, a dense fog, light rain, with thunder and lightning; very few mackerel taken the past week; 200 sail of the fleet are to-day detained in the harbor at Gloucester. On October 6 some good fares of fine mackerel were taken between Newburyport and Thatcher's Island. Among the vessels reported we notice the schooner Fannie Belle, 190 barrels; Lizzie Maud, 240; Onward, 80; Henry W. Longfellow, 80; Mystery, 260; Ellen M. Adams, 100; James and Ella, 300 barrels, the latter taken in Ipswich Bay. The fishing fleet are once more detained in this and other ports by high winds and rough weather. October 8 was a fine day, in which the fishing fleet were all busy. Between Eastern Point (just out from Gloucester Harbor) and Thatcher's Island 300 sail and three small steamers were busy in the catch of mackerel. The fish were of good size, mostly No. 2, and quite fat. From the bluffs at East Gloucester thirty seine boats were at one time counted, all busy taking fish. The catch for the day amounted to 6,500 barrels. Fifty vessels made hauls that averaged something over one hundred barrels each. This was the largest amount taken in any one day during the month.

October 9, the fleet worked over to Cape Cod, remaining off Cape Cod and in Barnstable Bay during the month. At times quite a body

of mackerel was found, and many vessels made good hauls. Much time was lost from stormy weather; the aggregate catch of the month was not up to expectation, and vessels began to leave for home ports. At the close of the month 150 sail had given up the catch, and about the same number remained for a short time longer.

Gulf of Saint Lawrence.—A few vessels from Massachusetts have remained about Prince Edward Island. Much of the time the weather was unfavorable for fishing, and but a very small amount was added to the catch. We quote from a letter received from Georgetown, Prince Edward Island, dated October 20: "Mackerel kept on the north side of the island this year, and scarcely any were taken on this side by boats or vessels. We can report this season as one of the worst and most unprofitable in the history of the fish business for our fishermen. We do not hear of any mackerel having been taken during the past two weeks."

Gill-net fishing.—As the schools of ground fish begin to draw in near the coast, the first of October finds the gill-net fishermen on the grounds with these nets that are now so generally used by the shore fishermen. Only a few years ago they were unknown to the American fishermen. On being introduced by the U. S. Fish Commission, in 1878, the shore fishermen soon saw the many advantages and value of them, gradually giving up the hook and line for gill-nets.

October 7, the first gill-nets were put down this season. Six nets were set on Brown's fishing-ground, 7 miles from Gloucester. These nets were hauled the next day, the catch being 1,000 pounds of codfish and 100 pollock that weighed 2,400 pounds; the pollock by gill-net catch averaged 24 pounds each. A few sail hand-line fishing on the same ground took but few fish, none of their pollock of over 12 pounds weight. Soon the hand-line fishermen gave it up. The catch by gill-nets increased daily, the fish coming in abundance, and more vessels and nets being engaged. The aggregate catch for the month amounted to 2,768,790 pounds of pollock and 112,770 pounds of codfish. The fishermen engaged in this catch live mostly at Gloucester; they leave home between 3 and 4 o'clock in the morning; having only 12 to 15 miles to go, they arrive on the fishing grounds at an early hour, run their nets, taking from 6,000 to 8,000 pounds of pollock and 1,000 to 3,000 pounds of codfish; are back in port, fish sold, and money received for same before dark, the fisherman averaging from $3 to $5 each for his day's work, spending his night at home, and being off again the next morning. This of course applies only to the time when the weather is favorable and fish remain in this immediate neighborhood. Another month will find fish and fishermen moved from their present location of Half-way Rock into Ipswich Bay, where the gill-net cod-fishing will be carried on during the winter.

Codfish receipts at Gloucester during the month aggregate 5,107,372

pounds of cured fish, direct from the several fishing-grounds, against 4,567,700 for the corresponding month of 1884. The Grand Banks fleet have nearly all returned, bringing full fares. The amount landed at Gloucester by the New England shore fleet, 235,135 pounds, is a large increase over the corresponding month last year, in which only 82,700 pounds was landed. The catch on George's Bank was light, caused largely by want of good fresh bait. The amount landed during the month was 1,964,000 pounds, as against 2,735,000 pounds in October, 1884.

Halibut receipts at Gloucester during October, 1885, 742,170 pounds; during October, 1884, 729,000 pounds.

The vessels that fished off Greenland and Iceland for halibut, with one exception, have all returned. There having been much bad weather, they took only partial fares. Schooner Alice M. Williams, of Gloucester, after securing her trip, on September 5 struck a rock off the Iceland coast and was soon a total wreck. The particulars, as given by the Boston Post, for November 17, 1885, are as follows:

"Capt. G. W. Pendleton, of the wrecked fishing schooner Alice M. Williams, has just returned home after a terrible experience of privation and hardship.

"'We left Gloucester,' he began, 'the latter part of July for Iceland, halibut fishing. We were the last of the fleet to start up for the season, and we had a very good catch, so that by the first of September we were nearly full with some of the finest fish I ever saw, and were about ready to come home. We were, September 5, on the southwest coast of Iceland, and about two miles from land, running before a brisk breeze, when all at once the vessel struck hard and fast. The weather was quite cold, and as the schooner struck on the rocks the seas made a clean breach over her. We launched our dories, saving some of our clothes and all the ship's instruments and charts.

"'The scene of the wreck was about two miles south of Bildall, and the rock was not laid down on the chart. We pulled to Bildall, which is a small Iceland town, composed of a series of mud huts, yelping dogs, shaggy ponies, miserable men and women, and a small army of dirty children. We could not get much to eat, for the poor creatures had very little for themselves, but we found that the only means of getting out of the country was by traveling thirty miles over the snow-covered mountains to a place called Thingyri, where, if we were expeditious, we would be in time to catch the last steamer of the season for Scotland. After a great deal of coaxing, threatening, and wrangling, I succeeded in getting possession of a little Iceland pony not much bigger than a rabbit, to the back of which I strapped the ship's instruments, and with a guide, who wanted all the money I had for his services, we started on a journey which, though not very long, proved to be one of the most severe and uncomfortable I ever experienced.

"'We left Bildall early one morning and set out bravely for the high-

lands, but night found us scarcely ten miles from our starting-point, in a thick snow-storm, and with the weather intensely cold. We lay down in the snow, but could not sleep, it was so cold, and although our traveling over the jagged rocks and drifting snow had made us weary, we were obliged to keep stirring in order to keep warm. The next morning we again started up the mountain. It had stopped snowing, but the cold increased as we ascended, and our party was pretty well used up. We did not halt the second night, but pushed on and arrived at Thingyri the next morning. This place was somewhat more of a town, and could boast of a few European residents, all Danes, however. One gentleman, in particular, a Mr. Gram, who makes yearly visits to Iceland to trade, kindly volunteered to lend me $850, without which we could not have got out of the country before next spring. We were obliged to wait at this place twenty days before the sailing of the steamer on which we were to embark for Scotland. My men, fourteen in number, had to sleep in the little round huts of the natives. Before the steamer arrived one of the men was taken very sick, and we hailed the arrival of the craft which was to take us away from this desolate shore with great pleasure, thinking our sufferings would soon be at an end. We landed at Granton after a twenty days' passage from Iceland, and went at once to Edinburgh, that being the nearest consulate. There were two other shipwrecked crews landed at the same time, a Danish and a Norwegian, who applied to their respective consuls for aid, and were met with immediate and full relief; but the American consul turned a deaf ear to our pressing wants. I then left him and was glad to get to Glasgow, where I immediately laid my case before Mr. Underwood, the American consul at that place, who approved my bill, gave me money with which to reimburse Mr. Gram, bought us clothing, and gave the men six shillings apiece and a passage home.'"

Stormy weather the past month has much of the time detained the fishing fleets in the nearest ports. As the season is fast drawing to a close, and with the mackerel in the best condition, time lost by detention is most severely felt. Our New England fishermen have been fortunate in having their losses of the month mostly confined to detention in the nearest ports during stormy weather.

On October 12 a severe gale off the Labrador coast was very disastrous to life and property. The fisheries off the Labrador coast the past season having in many cases proved a failure, the great loss by this storm is said to have been caused by the fishermen remaining out much later in the season than usual, being in hopes of helping out their catch from the great abundance of mackerel that were off that coast. We have in previous reports noticed the unusual and great quantities of mackerel off the Labrador coast this season. In past years they have seldom been seen and no attention paid to the catch, the natives scarcely thinking them a food-fish, or worth saving.

Receipts of fish at Gloucester, Mass., in October, 1885.

From—	Fares.	Mackerel.	Herring.	Codfish.	Pollock.	Haddock.
		Barrels.	*Barrels.*	*Pounds.*	*Pounds.*	*Pounds.*
New England shore	130	25, 662				
Gulf of Saint Lawrence	13	5, 293				
George's Bank	90			1, 964, 000		
Brown's Bank	5			143, 000		
La Have	7					
Nova Scotia, Cape Shore	11			581, 667		36, 667
Nova Scotia, Cape Shore*	1			40, 000		
Grand Banks	27			1, 930, 000		
Grand Banks*	1			40, 000		
Greenland, Flemish Cap	1			60, 000		
New England shore, trawl	38			235, 135	32, 000	37, 667
New England shore, hand-line	35			800	342, 000	
New England shore, gill-nets	201			112, 770	2, 768, 790	
New England shore, nets			4, 321			
Total	560	30, 915	4, 321	5, 107, 372	3, 142, 790	74, 334

From—	Hake.	Halibut.	Cusk.	Swordfish.	Fresh mackerel.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Barrels.*
George's Bank		68, 170		1, 131	
Brown's Bank		1, 700			
La Have		100, 000		488	
Grand Banks		532, 300			
Greenland, Flemish Cap		40, 000			
New England shore, trawl	282, 002		4, 500	2, 860	250
Total	282, 002	742, 170	4, 500	4, 479	250

*British vessels; fish paid duty.

Other receipts: dry fish, from Maine, 4,975 quintals hake, 1,970 quintals cod, 300 quintals haddock, 11,000 boxes smoked herring, 450 barrels pickled herring; fresh fish landed from market vessels and small boats, 70,000 pounds hake, 47,000 pounds cod, 15,000 pounds cusk.

11.—NEW ENGLAND FISHERIES IN NOVEMBER, 1885.

By W. A. WILCOX.

November brings in most of the fishing fleets that have been at work during the season. The mackerel, Grand Banks cod-fishery, shore herring, and eastern or Maine shore fisheries are over. From this until spring few ports except Gloucester will have any vessels on the fishing grounds.

Fish have been fairly abundant, and the catch, mackerel excepted, will show a gain of most varieties over that of 1884.

During the entire season the demand has been very moderate; competition, sharp; foreign importations, notwithstanding the duty, quite large. Prices so low that the season has been one of disappointment, with small if any profit.

The late or fall catch of mackerel was very light; at times quite a body of fish was found in Barnstable Bay and off Cape Cod, but high winds held the fleet in port much of the brief time while the fish remained, and only a small amount was added to the catch. The middle of the month found the catch given up by all except four vessels that were off the Nova Scotia shore; the latter all arrived during the month without a

barrel of fish, having been in provincial waters six weeks. On November 21, the last one of the mackerel fleet, the schooner Spencer F. Baird, arrived from a six weeks' cruise in the Gulf of Saint Lawrence and along the Nova Scotia shore, her trip being an entire failure, not taking a single mackerel; they reported much rough weather and the only mackerel seen were a few taken in nets by the Nova Scotia shore fishermen. The late fall catch off the Nova Scotia shore was almost an entire failure to the native fishermen as well as to American seiners. The full returns have not been received; enough are at hand, as reported on arrival, to show a decrease of about 85,000 barrels from that of the New England fleet in 1884.

Shore herring remained from the last of September to November 8; the catch was the largest for years; with full preparations, more than double the amount taken could have been secured. The catch about Cape Ann was as follows:

Location.	Boats.	Men.	Nets.	Herring.
				Barrels.
Gloucester	17	34	104	3,876
Rockport	75	125	150	1,500
Pigeon Cove	46	75	175	1,600
Lanesville	45	45	150	2,800
Total	183	279	579	9,776

Boats from Gloucester were larger and carried more nets than others mentioned.

Pollock were nearly all taken by gill-nets; aggregate 1,923,500 pounds, against 965,000 pounds the corresponding month last year; gain during November of nearly one million pounds.

Much of the time the past month fresh bait has been scarce, resulting in a decrease in the George's Bank and shore catch; squid have been abundant on La Have and Brown's banks; fish plentiful; good fares secured, the aggregate receipts of codfish at Gloucester being 2,978,424 pounds, against 2,223,000 in November, 1884.

Halibut receipts show a large gain. November, 1885, 658,100 pounds, against November, 1884, 108,400 pounds.

Mackerel landed at Gloucester in November, 1885, 6,564 barrels; while in November, 1884, it was 13,306 barrels.

Fortune Bay herring fleet will not be so large as last season, numbering then 22 sail. Schooner Commonwealth, of Gloucester, the first and only one to sail this month, left on November 21. The first to sail in 1884 was on November 24.

The most severe and longest storm for many years, extending the entire length of the coast, began in this section on Saturday p. m., November 21, and continued until Thursday night, November 26. Although much of the time the wind blew a gale, very little damage to the fishing vessels or other shipping has been reported. Vessels from

Grand, La Have, and George's Banks arrive in good order, and report rough weather, but not severe or anything like what it was near land.

The gill-net fishermen were severe sufferers by the storm, and it is the first time since the introduction of the gill-nets that they have met with any serious loss. Twelve sail report a loss of 132 nets, with anchors, buoys, &c., of the aggregate value of $2,658. Most of the nets lost were off Half-way Rock, on rocky bottom, in 24 fathoms; in Ipswich Bay a few were lost, on smooth bottom, in 15 fathoms; others in 30 fathoms were not damaged.

Receipts of fish at Gloucester, Mass., in November, 1885.

From—	Fares.	Mackerel.	Codfish.	Halibut.	Pollock.	Hake.	Haddock.	Cusk.
		Bbls.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Massachusetts shore, gill-nets	432		336, 624		1, 923, 500			
George's Bank	43		1, 015, 000	11, 000				
Grand Banks	18		200, 000	541, 800				
Grand Banks, British *	1			52, 000				
La Have Bank	18		677, 000	47, 000				
Cape shore	1		30, 000				10, 000	
Brown's Bank	21		674, 000	6, 300				
New England shore	23		12, 000			113, 000	33, 000	18, 500
Do	42	4, 999						
Gulf of Saint Lawrence	10	1, 565						
Small boats			33, 800		18, 000	50, 000		8, 000
Total	609	6, 564	2, 978, 424	658, 100	1, 941, 500	163, 000	43, 000	26, 500

* Free of duty.

Other receipts: From Maine, 110 barrels of herring, 2,374 quintals of hake, 230 quintals of haddock; from Rhode Island, 900 barrels fish oil. Imports from the provinces: 1,950 quintals hake, 24 quintals pollock, 2,600 boxes smoked herring.

12.—NEW ENGLAND FISHERIES IN DECEMBER, 1885.

By W. A. WILCOX.

During most of the month the weather was unfavorable for fishing, there being high wind and sea and a succession of gales. The small amount of fishing that was attempted on George's Bank and off the New England coast was accompanied with severe and many losses to nearly all engaged. The gill-net fishermen have not been able to fish one-half of the time, and have suffered severely in the loss of nets. Receipts of the month have mostly been from La Have Bank, where codfish of fine size and quality have been abundant; and vessels from there were mostly outside of the severe gales, suffered but little, and arrived with good fares. Squid were found in great abundance on La Have Bank, furnishing plenty of the best of bait. This was very fortunate, as most of the weirs were damaged by storms or taken up, and little bait could be procured along the coast.

On December 7 a severe gale badly damaged weirs, nets, and all fishing property that was exposed. From December 25 to 27 the most severe gale for many years extended the entire length of our Atlantic

coast, as well as far inland. This is remembered as the "Christmas gale." The following fishing vessels and lives were lost: Schooners Cleopatra and four men, Racer, Adelia Hartwell, and Ivanhoe. Three men were lost from the schooner Lizzie Griffin and one from the Lillian Baxter. Total, 4 vessels and 8 men, from Gloucester. The Portland schooner Breeze and the Nova Scotia schooner S. E. Killam, and master, were also lost in the same gale.

All vessels that arrived for some time reported the roughest weather for many years, and most of them were more or less damaged. The Grand Banks halibut fleet were outside of the gale and arrived in good order. They experienced rough weather, arriving with small fares. During the month weir-fishing was finished until spring. On account of the many storms and much damage, it has not been very profitable. The ten weirs located near Provincetown report as follows: Put down April 20, taken up December 12, during which time they caught as follows:

Kind of fish.	Quantity.	Kind of fish.	Quantity.
Mackerel, cured .... barrels..	792	Cod, pollock, and hake .... pounds..	62,300
Mackerel, sold fresh .... do...	975	Bluefish .... do....	1,000
Herring, cured .... do....	1,075	Smelts .... do....	5,900
Herring, sold fresh .... do....	3,550	Eels .... do....	2,500
Squid .... do....	1,670	Flounders .... do....	10,000

Prices at the weirs averaged: herring, $1.25 a barrel; squid, $1 a barrel; smelt, 10 to 12 cents per pound; eels, 9 cents per pound.

During the month fleets have sailed on frozen-herring trips to Fortune Bay, Newfoundland, as follows:

Schooner Commonwealth sailed November 20; schooner Cecil H. Low, November 27; schooner Henri N. Woods, December 2; schooner Mystery, December 3; schooner Mary Fernald, December 3; schooner Gov. Butler, December 4; schooner Nellie M. Davis, December 4; schooner Mary E. McDonald, December 5; schooner Samuel V. Colby, December 5; schooner Spencer F. Baird, December 8; schooner Jennie Seaverns, December 8; schooner Herman E. Babson, December 9; schooner Edith S. Walen, December 10; schooner Centennial, December 11; schooner Laura Nelson, December 13; schooner Maggie and Lilly, December 14; schooner Electric Light, December 18; schooner William D. Daisley, December 19; schooner Warren J. Crosby, December 19; schooner Arthur D. Story, January 1, 1886. Total, 20 sail, all belonging to the port of Gloucester. No other vessels from the United States will go to Fortune Bay for herring this season.

The Eastport or Bay of Fundy herring fleet, from Gloucester, began to start on their trips on December 4, the following vessels having sailed during the month: Schooners Goldsmith Maid, Ada R. Terry, Volunteer, Argonaut, Annie E. Lane, Joseph Story, Margie Smith, William H. Foye, Porter S. Roberts, Frederick P. Frye, Hattie Evelyn,

Rattler, and E. W. Merchant; total, 13 sail. A number of vessels from Eastern ports will also engage in this branch of the business.

Very few herring have been taken during the month, the weather not having been cold enough for freezing; and vessels are delayed. The last reports from Fortune Bay were that the weather was very mild.

The demand for all kinds of fish has been very light all through the month, notwithstanding prices have been lower on all varieties than one year ago—a fact that may be noted that ever since the restoration of the duty at no time have prices been as high as of late years, when free of duty. This is largely accounted for from the great reduction and present low price of other leading provisions.

Receipts of fish at Gloucester, Mass., in December, 1885.

From—	Fares.	Codfish.	Halibut.	Haddock.	Hake.	Pollock.	Cusk.	Oil.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Barrels.*
La Have Bank	51	2, 253, 000	12, 800	....	....	....	....	....
Grand Banks	20	87, 000	492, 000	....	....	....	....	....
Banquereau	1	....	25, 000	....	....	....	....	....
Brown's Bank	2	38, 000	200	....	....	....	....	....
New England shore, netters	135	398, 800	....	....	....	22, 150	....	....
New England shore, trawlers	35	90, 500	....	91, 600	20, 500	2, 000	2, 000	*500
Total	244	2, 867, 300	530, 000	91, 600	20, 500	24, 150	2, 000	500

* From Tiverton, R. I.

13.—INSPECTION OF FISH AND OTHER MARINE PRODUCTS IN THE DISTRICT OF COLUMBIA.

By CHAS. W. SMILEY.

For several years a careful inspection of the marine products brought into the District of Columbia has been made under the direction of the health officer of the District. By the courtesy of that officer, Dr. Smith Townshend, the Fish Commission has been permitted to compile annual tables which show the trade in fresh fish in this city. Tables for 1879, 1880, 1881, 1882, and 1883 will be found on pages 2–6 of the Bulletin for 1884; for 1884 on page 105 of the Bulletin for 1885; and for 1885 on the following page. Following is a summary table of the results:

Kinds.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
Oysters*	259, 356	378, 295	315, 296	411, 255	400, 564	307, 832	330, 005
Terrapin†	1, 452	3, 154	2, 574	834	1, 646	264	....
Turtles†	454	501	117	116	95	126	55
Clams†	1, 167, 000	1, 384, 950	1, 131, 000	1, 219, 850	1, 380, 000	1, 847, 900	1, 758, 900
Crabs†	528, 400	682, 370	314, 800	527, 001	690, 372	859, 200	722, 400
Shad†	311, 585	320, 799	458, 368	350, 292	261, 478	231, 111	125, 458
Sturgeon†	1, 200	1, 176	1, 289	1, 904	1, 673	1, 588	1, 174
Herring†	3, 605, 984	6, 853, 721	9, 633, 568	6, 499, 865	4, 983, 998	5, 640, 812	9, 813, 544
Bluefish‡	248, 295	371, 988	196, 353	224, 040	243, 025	226, 420	200, 330
Perch‡	297, 865	1, 051, 392	1, 044, 145	229, 558	284, 955	320, 170	273, 975
Catfish‡	401, 850	469, 820	874, 465	271, 597	214, 515	243, 665	312, 985
Rockfish‡	148, 215	406, 138	395, 370	334, 865	274, 860	340, 460	300, 915
Other fish‡	294, 427	619, 622	218, 512	283, 046	383, 775	478, 085	336, 904

* Bushels. † Number. ‡ Pounds.

Monthly summary of the fresh fish, oysters, &c., inspected by the Health Officer of the District of Columbia during the year 1885.

Kinds.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Carp (number)	67		40										107
Catfish*	29,065	7,160	35,100	40,875	19,105	20,030	33,195	32,435	17,740	27,870	27,295	23,115	312,985
Chubs of North Carolina*a	3,675	1,800		560					555		6,650	5,400	18,640
Clams (number)	1,200				323,000	408,700	449,000	438,000	133,000	6,000			1,758,900
Crabs (number)					176,900	197,200	145,400	119,000	81,600	2,300			722,400
Croakers*						1,340	300						1,640
Drumfish (number)					9	2		2		3			16
Eels*	505		380	10,940	8,095	1,995	1,600	1,375	1,900	2,875	3,875	3,060	36,600
Herring (number)			42,912	5,803,703	3,912,086	54,843							9,813,544
Hogfish*b						105							105
Mullets, freshwater*	6,215	1,965	5,270	4,205			1,280		380	4,815	5,490	3,780	33,400
Oysters (bushels)	42,850	22,490	27,900	14,320	750		420	600	24,325	70,050	70,700	55,600	330,005
Perch, white*	1,270	2,425	25,500	39,715	4,080	5,305	10,365	6,550	11,785	28,265	32,275	12,785	180,320
Perch, yellow*	16,720	7,410	17,665	24,650	215	1,225	785			3,665	7,775	13,525	93,635
Pike*	4,145	2,615	9,315	7,375	1,600	835	1,840	110		7,895	8,965	7,265	51,960
Rockfish*c	4,245	1,230	14,280	40,195	6,130	23,270	39,760	23,160	29,340	41,815	53,880	23,610	300,915
Scup (number)d					100	391	80						571
Shad (number)			6	55,155	68,450	1,847							125,458
Sharks (number)							2						2
Sheepshead (number)					242	302	131	269	189				1,133
Spanish mackerel (number)						1,051	1,052	829	1,036				3,968
Spots*						1,035	1,665	9,660	20,185	8,660			42,205
Sturgeon (number)				4	310	464	67	172	156	1			1,174
Tailors, freshwater (number)e			71	5,630	67								5,768
Tailors, saltwater*f					2,200	50,760	36,820	30,905	53,545	26,100			200,330
Trout*					19,850	9,605	g5,585	g4,540	g13,155	35,455			88,190
Trout, salmon (number)									74				71
Turtles, green (number)						30	17			6	2		55
Winter shad*h	6,545	3,565	870							3,525	6,330	13,220	34,055

* Reported in bunches, but here reduced to pounds, on the basis of 5 pounds to the bunch.
a Or big-mouth black bass.
b Or grunts or pigfish.
c Or striped bass.
d Or scuppaug or porgies.
e Or hickory shad or tailor shad.
f Or bluefish.
g Reported as gray trout [or squeteague].
h Or mud shad.

Vol. VI, No. 4. Washington, D. C. Feb. 27, 1886.

14.—NEW ENGLAND FISHERIES IN JANUARY, 1886.

By W. A. WILCOX.

With the New England fishermen January may be called the vacation month of the year. Of the fifteen hundred and odd vessels that during the past year were engaged on the fishing grounds, extending from the Gulf of Mexico along the American coast to distant Greenland and Iceland, only a comparatively small number are engaged during midwinter. The crews can then rest, travel, or engage in such work ashore as can be found. Many of them may be met at the country store or at the fishing station talking about and comparing notes of the previous year and of former years. Or he may be found with pencil and tools drafting and modeling what he expects will be an improvement on that which is now generally known as the finest fishing vessel of the world. Others are away in the far West, sometimes on the Pacific coast, often settling down in new homes and helping to develop the resources of the nation. In some cases he may be found as the country school-teacher or as a village pastor. He easily adapts himself to time and circumstances. Gloucester alone, of all New England ports, actively follows the winter fisheries. During most of the month the weather has been rough and unfavorable for fishing, arrivals few and receipts light, yet in excess of the corresponding month in 1885. On January 8 and 9 another severe storm, although not so long, was nearly, if not quite, as severe as the one of two weeks previous. The following vessels were lost from the fishing fleets: From Gloucester, schooner I. H. Higgins, vessel lost, crew saved; schooner Hyperion, with a crew of 12 men, sailed December 7; schooner Mabel Dillaway, with a crew of 16 men, sailed on December 20, was not seen after December 25. The last two mentioned vessels, with all hands, have been given up, and are supposed to have been lost in the gale of December 25 to 27.

The schooner Gertie Freeman, of Newburyport, was wrecked off New Castle, N. H.; crew saved. Schooner Nimble, of Boston, was lost on the Graves just outside of Boston Harbor.

The schooner Alice M. Gould, of Portland, Me., was wrecked off Jordan's Point, Me.

In addition to the above-mentioned losses to the fishing fleet, many coasting vessels were lost, and nearly all vessels that were exposed received more or less damage.

Probably no other industry carried on in this country shows yearly such a large loss in life and property as the New England fisheries.

Gloucester alone has the sad record, from 1830 to 1882, fifty-two years, of 419 vessels and 2,249 lives, an annual average of 8 vessels and 43 lives.

Fortune Bay, Newfoundland, herring fishery.—The schooner Cecil H. Low, of Gloucester, was the first arrival with a cargo of frozen herring, having sailed from Newfoundland January 15, arrived the 22d, with 400,000 herring. She reports the weather very mild, herring abundant; a large amount taken, but for want of freezing weather thrown away. Other arrivals from there during the month: Schooner Commonwealth, 380,000; Henri N. Wood, 300,000; Electric Light, 400,000; and one British vessel, schooner Annie Robinson, 350,000. The last two proceeded on to New York for a market.

Bay of Fundy herring.—The fleet for frozen herring remained idle during December, waiting for freezing weather and more fish. During the past month the catch has improved, and suitable weather for freezing has enabled the following vessels to load and arrive at Gloucester:

Name of vessel.	Date of arrival.	Number of herring.
Joseph Story	January 5	140,000
Argonaut	January 13	218,000
William H. Foye	January 14	240,000
Goldsmith Maid	January 14	180,000

The arrivals from Fortune Bay and the Bay of Fundy find a ready market for cargoes, which are largely used for fresh bait as well as for food. The price is the same for fish from either place, ranging from 75 cents to $1.25 per 100 by actual count.

The Ipswich Bay cod fleet have found fish quite plentiful, but have had only a few days of suitable weather for fishing. Vessels engaged during the month: 20 sail with gill-nets, and 25 with trawls. The former have suffered severe losses in the numerous gales, many nets being lost and others being badly damaged. The catch is nearly all sent to the Boston market fresh, being landed at the nearest ports accessible to the railroad. The amount of codfish landed by this fleet of netters during the month at Portsmouth, N. H., was 99,000 pounds, and at Rockport, Mass., was 45,000 pounds.

The Grand Banks halibut vessels arrive with light fares, that find quick sale at good prices. They report much rough weather and high seas, but no gales or severe storms like those off the New England coast and George's Bank.

The new year opened with a dark cloud over the fishing industry. One storm was scarcely over before it was followed by another. The coast was strewed with wrecks, and many lives were lost. In addition to which the agitation of the fisheries question by Congress, and doubts and uncertainty for the future, all had a depressing effect, and little courage was felt to engage in the business for the new year.

With the close of the month a much better feeling is shown; disasters and losses of the past are not thought so irreparable, as long as there is a prospect of some protection being giving the industry by the General Government.

Receipts of fish at Gloucester, Mass., January, 1886.

From—	Fares.	Codfish.	Halibut.	Haddock.	Frozen herring.	Pickled herring.	Oil.
		Pounds.	*Pounds.*	*Pounds.*	*Count.*	*Barrels.*	*Barrels*
La Have Bank	5	210,000	2,000				
Grand Banks	14		463,700				
Brown's Bank	3	111,000	11,000				
Banquereau	1		25,000				
Western Bank	1	30,000	6,000				
George's Bank	7	112,000	10,100	5,000			
Eastport, Me	11				2,531,000		
Fortune Bay, Newfoundland	4				1,480,000		
Fortune Bay, English	1				350,000		
New England shore, netters	11	40,000					
New England shore, trawlers	4	7,000		10,000			
Maine	1					220	
Tiverton, R. I	1						225
Total	64	510,000	517,800	15,000	4,361,000	220	225

15.—THE FISHERIES OF CANADA IN 1884.*

GENERAL REMARKS ON THE PROVINCES.

Nova Scotia.—The returns show that the fisheries of this Province do not only maintain the improvement of the last few years, but they show a large increase over any former year. While this improvement embraces nearly all kinds of fish, it is most marked in cod, mackerel, herring, salmon, and lobsters.

The encouragement offered by the bounty has largely increased the number of vessels and boats engaged in the deep-sea and shore fisheries.

New Brunswick.—From this Province the returns show a large increase in the yield of its fisheries. A most gratifying feature is the general improvement in the salmon fishery, which extends to almost every district in which this fishery is pursued. Smelt, herring, and lobsters show increased catches. Shad and alewives also share in the general improvement, but the sturgeon fishery shows a large falling off from former years. In some districts the herring fishery was not so productive, while in others it shows a largely increased catch. This is no doubt due to the erratic movements of the schools of this fish, which, while never leaving our coast, change their habitat according to temperature, weather, and the location of their favorite food.

Quebec.—The late date at which the ice left in the spring, and the stormy weather which almost constantly prevailed in the Gulf during

* Extracts from the Annual Report of the Department of Fisheries, Dominion of Canada, for the year 1884.

the fishing season, has caused a considerable decrease in the catch of almost all kinds of fish. The decrease in the catch of salmon on the south shore of Gaspé and Bonaventure is, however, counterbalanced by the increased catch on the north shore.

More interest than usual was taken in the mackerel fishery, and considerable outlay was made by local fishermen; but unfavorable weather doubtless affected the movements of the schools, which did not go to the west of Cape Breton, and the catch made was inconsiderable.

The inland fisheries show a large decrease as compared with the catch of 1883. This falling off, which was noticeable in almost every kind of fish, is due more to a prevalence of contrary winds and stormy weather than to any scarcity of fish.

Prince Edward Island.—The stormy and unfavorable weather which prevailed in the Gulf extended also to the straits, and had the same effect on the island fisheries. The returns show a large falling off in all kinds of fish, the decrease being most marked in mackerel. The single exception is the lobster fishery, which, contrary to general expectation, has been good, and the returns show a considerable increase over the very large catch of last year.

The enormous extent to which this fishery has been developed and the constantly increasing number of factories and fishermen have led to much confusion. It will soon be necessary, in the interest of the fishery, as well as of the fishermen and packers, to bring it under the more effective control of the Department.

British Columbia.—The returns from this Province show a large decrease in the salmon catch of the Fraser River, where only six canneries out of thirteen were in operation. This result was not due to any scarcity of fish, but to the large quantity of preserved salmon on the market and the low prices obtained.

A fish hatchery, measuring 100 by 40 feet, was built during last season on the Fraser River. It will easily accommodate 3,000,000 quinnat salmon eggs or 5,500,000 saw-quái [or "suk-kegh," a name for blue-back salmon?] salmon ova. By doubling the trays, double this number of eggs can be laid down. The catching of parent salmon began about the beginning of July, and by the close of the season 3,000,000 eggs were on the trays. The operations were highly successful, and reflect credit upon the officer in charge, Mr. Thomas Mowat.

Ontario.—The total value of the fisheries in the Province of Ontario is reckoned at $1,133,724.26. On Lake Superior, Lake Huron, and Georgian Bay the individual catches did not much exceed those of last year, but the number of fishermen was larger and the aggregate yield consequently increased. The severe stormy weather which prevailed during the first part of November greatly interfered with the fishermen's operations by damaging or destroying a large amount of twine and driving the runs of fish off the reefs; but, on the whole, the result was satisfactory.

PRODUCE OF THE FISHERIES.

The total value of the fisheries of Canada for the year 1884 is reckoned as follows:

Nova Scotia	$8,763,779 36
New Brunswick	3,730,453 99
Quebec	1,694,560 85
British Columbia	1,358,267 10
Ontario	1,133,724 26
Prince Edward Island	1,085,618 68
Showing a total value of	17,766,404 24

as against $16,958,192.98 in 1883, an increase of $808,211.26.

This is exclusive of the quantity consumed by the Indian population of British Columbia, and also of the yield of Manitoba and the Northwest Territories, from which, although steps have been taken to supply the information in future, no reliable data are available for the present report.

The following table is valuable for its recapitulation of the yield of the different kinds of fish throughout Canada during 1883 and 1884, with a comparison of the products of these years:

The yield and value of fisheries in the Dominion of Canada for the years 1883 *and* 1884.

Kinds of fish.	1883.		1884.	
	Quantity.	Value.	Quantity.	Value.
Cod ... cwts..	1,074,914	$4,507,110 25	1,022,234	$4,302,454 85
Herring:				
Pickled ... barrels..	443,611	1,825,355 50	493,241	2,029,430 00
Smoked ... boxes..	1,247,660	311,915 00	1,938,194	484,548 50
Frozen ... number..	20,875,000	125,100 00	14,851,500	89,109 00
Preserved or fresh ... pounds..	7,968	956 16	1,049,550	42,559 50
Lobsters:				
Preserved ... do...	13,364,020	1,889,265 71	15,933,283	2,259,892 80
Preserved ... tons..	964	29,310 00	3,065	91,967 00
In shell or alive ... per M..	1,195,120	30,678 00		
Salmon:				
Pickled ... barrels..	6,030½	63,901 50	10,049	123,418 50
Fresh ... number..	117,664	44,287 20	173,056	51,916 80
Fresh in ice ... pounds..	1,537,052	262,810 44	2,608,268	346,000 29
Preserved in cans ... do...	9,460,911	1,087,218 35	6,803,845	781,366 05
Smoked ... do...	419,363	59,909 02	385,230	55,026 09
Mackerel:				
Preserved in cans ... do...	702,743	94,853 46	190,457	28,194 03
Pickled ... barrels..	124,093	1,234,632 00	180,170	1,798,487 00
Haddock ... cwts..	173,092	609,966 50	216,544	758,245 70
Hake ... do...	146,281	511,983 50	40,073	140,255 50
Pollock ... do...	105,573	369,505 50	78,635	275,222 50
Trout ... pounds..	4,744,529	368,323 12	5,517,487	429,481 00
Trout ... barrels..	4,099	40,672 00	3,546½	35,172 00
Whitefish ... do...	1,862	18,620 00	2,078	20,780 00
Whitefish ... pounds..	3,120,032	249,602 56	3,139,891	251,191 28
Smelts ... do...	4,180,943	254,456 58	6,177,410	370,644 60
Sardines ... barrels..	15,294	45,896 00	8,895	26,720 00
Sardines ... hogsheads..	37,717	301,736 00	35,788	357,880 00
Oysters ... barrels..	50,540	151,620 00	41,956	126,478 00
Alewives ... do...	37,707	150,498 00	47,674	189,854 50
Hake sounds ... pounds..	115,687	110,222 80	83,637	77,726 20
Cod tongues and sounds ... barrels..	1,943	14,433 00	2,006	14,882 00
Shad ... number..	192,800	17,843 75	128,533	12,157 17
Shad, salted ... barrels..	7,076½	56,612 00	7,737	61,901 24
Eels, salted ... do...	3,482½	31,246 50	4,776	42,768 40
Eels ... number..	514,219	51,421 90	419,464	41,946 40
Muskallonge ... pounds..	771,070	49,257 20	627,750	39,573 30

The yield and value of fisheries in the Dominion of Canada, &c.—Continued.

Kinds of fish.	1883.		1884.	
	Quantity.	Value.	Quantity.	Value.
Bass .... pounds..	1, 181, 923	$74, 551 04	$1, 186, 423	$75, 571 26
Pickerel .... do...	1, 671, 539	105, 011 66	1, 771, 071	111, 452 06
Pike .... do...	930, 020	45, 361 00	705, 948	36, 363 40
Sturgeon .... do...	1, 041, 278	54, 006 30	1, 601, 306	80, 709 60
Sturgeon .... barrels..	1, 866	9, 330 00	1, 638	8, 190 00
Halibut .... pounds..	1, 066, 050	62, 493 00	1, 670, 215	98, 532 90
Barfish and whitefish .... dozen..	14, 050	27, 562 50	15, 008	18, 760 00
Winnonish .... number..	21, 500	5, 375 00	25, 600	6, 400 00
Tomcod .... barrels..	4, 000	6, 000 00	2, 080	3, 120 00
Perch .... pounds..	10, 450	627 00	12, 000	720 00
Ling .... cwts..	207	828 00	155	620 00
Squid .... barrels..	4, 470	17, 672 00	3, 176	12, 704 00
Whiting .... pounds..	25, 000	1, 530 00	....	....
Eulachon, pickled .... barrels..	187	1, 517 00	330	2, 640 00
Eulachon, fresh .... pounds..	30, 000	1, 800 00	37, 500	2, 250 00
Eulachon, smoked .... boxes..	4, 050	4, 050 00	2, 800	2, 800 00
Seal skins .... number..	9, 195	91, 950 00		
Hair-seal skins .... do...	22, 036	20, 586 00	....	166, 788 00
Sea-otter skins .... do...	96	4, 800 00		
Porpoise skins .... do...	87	298 00	83	332 00
Fish oils, not assorted .... gallons..	632, 690	401, 726 60	583, 883	376, 826 10
Whale oil .... do..	5, 510	2, 505 00	4, 640	2, 320 00
Seal oil .... do...	127, 749	76, 649 40	50, 070	25, 035 00
Cod oil .... do...	121, 631	72, 978 60	83, 391	41, 695 50
Dogfish, porpoise, &c., oil .... do...	222, 018	89, 886 40	16, 781	6, 766 89
Dogfish oil, refined .... do...	40, 000	22, 000 00	45, 000	24, 800 00
Clams, preserved .... pounds..	8, 640	1, 080 00	14, 400	1, 800 00
Fish roes .... barrels..	46	108 00	18	72 00
Coarse fish .... do...	15, 230	60, 920 00	45, 227	198, 726 26
Mixed fish .... do...	24, 546	101, 068 68		
Fish scrap, dried .... tons..	20	300 00	....	....
Fish guano .... do...	2, 873	43, 095 00	4, 422	66, 330 00
Fish used for bait and manure .... do...	25, 250	225, 818 50	250, 572	204, 875 25
Fish sold in Halifax markets	....	31, 500 00	....	52, 400 00
Fish sold in Victoria, B. C., markets	....	105, 000 00	....	110, 000 00
Fish assorted in British Columbia	....	2, 430 00	58, 400	3, 504 00
For home consumption, not included in returns..	....	215, 558 30	....	266, 170 00
Total value of the fisheries in Canada	....	16, 958, 192 98	....	17, 766, 404 24

FISH BREEDING IN 1884.

The general success of the several institutions during 1884, as given below, will be found satisfactory, as evidencing the onward progress of the work as a whole, although returns from some of the hatcheries do not show as large a crop of ova laid down as in the previous year of 1883. The falling off in the quantity of eggs was occasioned by a less number of parent salmon having been captured at some of the stations than during the season of 1883.

There are now twelve establishments for the propagation of fish by artificial methods, in actual operation in the several provinces of the Dominion. These hatcheries are all at the present time (December 31, 1884) largely filled with fish eggs which have been collected at various points throughout Canada during the spawning season of 1884. The latest hatchery erected on the Fraser River in British Columbia was completed only in time to receive its first crop of ova last autumn.

Particulars relative to the rearing and distribution of fry from eleven of the above-mentioned nurseries during the spring of 1884 are herewith submitted in detail; likewise a descriptive account of the quanti-

ties and species of eggs that were laid down in each of the twelve hatcheries last autumn is given below.

The total number of young fish of various kinds hatched and turned out of these eleven institutions into many of the rivers and other waters of Canada in 1884 amounted to 53,143,000; and the total quantity of eggs laid down in all the hatcheries in the fall of 1884 was 66,033,000.

The particular number and description of young fish bred in each of the nurseries in the several provinces during the hatching season or spring of 1884 was as follows:

Sydney hatchery, Nova Scotia	salmon	853,000
Bedford hatchery, Nova Scotia	do	1,000,000
Dunk River hatchery, Prince Edward Island	do	1,000,000
St. John River hatchery, New Brunswick	do	811,000
Miramichi hatchery, New Brunswick	do	795,000
Restigouche hatchery, Quebec	do	940,000
Gaspé hatchery, Quebec	do	859,000
Tadoussac hatchery, Quebec	do	985,000
Magog hatchery, Quebec	salmon trout	100,000
Newcastle hatchery, Ontario	do	5,150,000
Newcastle hatchery, Ontario	speckled trout	50,000
Newcastle hatchery, Ontario	whitefish	3,500,000
Newcastle hatchery, Ontario	black bass	100,000
Sandwich hatchery, Ontario	whitefish	27,000,000
Sandwich hatchery, Ontario	pickerel	10,000,000
Total of fry of all kinds		53,143,000

These were divided by species as follows:

Salmon, *Salmo salar*	7,243,000
Salmon trout, *Salmo lacustris*	5,250,000
Speckled trout, *Salmo fontinalis*	50,000
Whitefish, *Coregonus albus*	30,500,000
Pickerel,* *Lucioperca*	10,000,000
Black bass, *Grystes nigricans*	100,000
Total	53,143,000

The particular number and description of fish eggs laid down in each of the nurseries of the several provinces during the spawning season or fall of 1884 was as follows:

Fraser River hatchery, British Columbia	salmon	3,000,000
Sydney hatchery, Nova Scotia	do	931,000
Bedford hatchery, Nova Scotia	do	800,000
Dunk River hatchery, Prince Edward Island	do	1,250,000
Miramichi hatchery, New Brunswick	do	1,000,000
St. John River hatchery, New Brunswick	do	186,000
Restigouche hatchery, Quebec	do	700,000
Gaspé hatchery, Quebec	do	341,000
Tadoussac hatchery, Quebec	do	775,000
Magog hatchery, Quebec		No return.

*This is variously known as lake pickerel, pike perch, wall-eyed pike, doré, dory, *Stizostedium*.

Newcastle hatchery, Ontario	salmon trout	4,000,000
Newcastle hatchery, Ontario	speckled trout	50,000
Newcastle hatchery, Ontario	whitefish	3,000,000
Sandwich hatchery, Ontario	do	50,000,000
Total of eggs of all kinds		66,033,000

These were divided by species as follows:

Salmon, *Salmo quinnat*	3,000,000
Salmon, *Salmo salar*	5,983,000
Salmon trout, *Salmo lacustris*	4,000,000
Speckled trout, *Salmo fontinalis*	50,000
Whitefish, *Coregonus albus*	53,000,000
Total	66,033,000

16.—EXPERIMENTS WITH SALMON IN SCOTLAND.

By FRANCIS DAY, F. L. S.

[Conclusions of paper read before the Linnean Society of London, March 5, 1885.]

The unbiased investigator must admit that, so far as they have gone, the experiments made at Howietoun among the *salmonidæ* are pretty conclusive on the following points:

(1) That male parrs and smolts may afford milt competent to fertilize ova, but when from fish of the second season, or up to 32 months old, it is (? always) of insufficient strength for strong and vigorous fry to be raised.

(2) That female smolts or grilse may give eggs at 32 months of age, but those which are a season older are better capable of producing vigorous fry; while for the purpose of developing ova, a visit to the sea is not a physiological necessity.

(3) That young male *salmonidæ* are more matured for breeding purposes than are young females of the same age.

(4) That although females under 24 months of age may give ova, such are of little use for breeding purposes, the embryos not becoming well developed or vigorous, while the young when hatched are frequently malformed.

(5) That the size of the eggs of *salmonidæ* varies with the age and condition of the parent; but, as a rule, older fish give larger ova than do younger and smaller ones.

(6) That among the produce of every female fish there may be found variations in the size of the eggs.

(7) That from larger ova finer and more rapidly growing fry are produced; consequently that, by selection of breeders, races may be improved; while it is only where segregation is well carried out that such selection is possible.

17.—CARP CULTURE IN GERMANY.*

By XAVER VON STABROWSKI.

The carp is the easiest fish to cultivate, and it is the best adapted to most of the waters of our country. It flourishes in both stagnant and running water, if it is warm and contains sufficient food. Its power of reproduction is very great, as many as 500,000 eggs having been counted in a carp weighing 3 kilograms [about 6½ pounds]; and it grows so rapidly that in its third year it is fit for the table. Its scales, with their golden glitter and black shading, give it a pretty appearance. For these reasons it is the favorite fish of our nation, and it is more sought after and fetches a higher price in the market than the pike. The carp is exceedingly voracious and not at all particular as to its food. In fact, it eats anything from meat to manure. It has therefore been said that, in some respects, it is among the fish what the hog is among the mammals.

The carp is a gregarious fish, and is generally found in large schools. This shows that it is not a predaceous fish. It is sportive and sly. No other fish engages in such constant gambols as the carp. It is a prudent fish. When a drag-net is used the carp places itself perpendicularly in front of it, with its head in the mud, so that the lower rope of the net upsets it, giving it a horizontal position, the net meanwhile gliding over its body. On the other hand, if the carp cannot perform this maneuver, it boldly leaps over the upper rope of the net.

If good and early results are to be obtained, one should proceed in the following manner: Instead of draining the spawning pond in October, this should be done in July. The young fry, measuring 3 to 4 centimeters [about 1¼ inches] in length, are placed in the raising pond, which should be prepared for the reception of the young carp in the following way: During the preceding autumn the pond should be drained and exposed to the air as well as to the frost, so as to banish the noxious gases, which prove fatal to the fish, as well as all hurtful worms, insects, small fish, and frogs. During the following spring the pond is plowed and oats and clover are sowed in it, which are harvested when still green, about the middle of June. After three weeks the clover has again grown high enough and is full of many different insects and worms, which are the most suitable food for the little fish.

When (in July) the young carp are to be placed in this pond, only a small portion of it should be set under water; each week the quantity of water should be increased, thus setting a constantly larger area of the pond under water, and constantly furnishing new food for the fish.

---

* "*Der Karpfen* (*Cyprinus carpio*)." From the *Deutsche Fischerei-Zeitung*, Vol. VIII, No. 49, Stettin, December 8, 1885. Translated from the German by HERMAN JACOBSON.

This is continued till October, at which time the carp do not take any more food. Now, the pond is drained, and the fish are taken out. A raising pond worked in this way will in autumn reward us for our care and trouble by carp weighing half a pound each. The carp are then taken to the so-called winter pond, and in spring distributed among the stock ponds, which have been prepared and treated in the same manner as the raising ponds. For providing further food for the carp, a dead sheep, cow, &c., which has been skinned, may be thrown into the pond, leaving it whole, so that when the pond is drained, the entire skeleton can easily be removed.

I urgently recommend the feeding of the carp, because this will amply pay. If we feed the fish, we can place double the number in the same water, and they will increase rapidly in weight. I am in the habit of putting the vegetable food destined for the carp on a very simple apparatus, forming a sort of table, which has a raised edge on three sides, and a ledge in the middle. The food placed on this apparatus will accumulate along the middle and lower ledge, which of course must be under water, and from which the fish take their food as from a crib. The food may consist of potatoes, peas, husks, carrots, pumpkins, and even refuse from the kitchen may be used. There is also another cheap food for carp. Oat straw is chopped very fine, then put into a hole in the ground, measuring 2 to 3 square meters, and 30 centimeters [about 1 foot] deep, whose walls are lined with brick; blood is poured over the straw; and enormous numbers of maggots will form, which are taken up with a shovel and thrown into the pond. This should not be done, however, until the maggots are of a dark color, and are therefore fully grown. The hole should be covered with a board.

Carp taken from this stock pond during October of the first year will weigh from 1½ to 2 kilograms [about 3 pounds].

Although the carp when brought to our markets are still too dear, it is not difficult to sell them favorably. The fish-dealers know how to take advantage of our situation at the time when the pond is drained. To prevent this a special pond is needed, to which the fish may be removed from the stock pond. This pond may be considered as a storehouse for fish, from which the necessary quantity of fish is taken to suit the demands of the fish-dealers. In this pond are also kept the fish-boxes, always containing a few hundredweights of fish for the retail trade and for home consumption. This "store pond" need not be very large, but it should be at least 2½ meters deep [about 8 feet], and be fed by a strong current of constantly running water. During winter the carp in this pond need not be fed, because all fish of the *Cyprinus* kind, like the carp, tench, crucians, &c., do not take any food in winter. The fish-box greatly facilities the retailing of fish, which I would highly recommend, as a much higher price can thus be obtained than what the fish-dealers pay.

In transporting fish they should be packed in damp moss which has

not been taken from the woods, but from humid meadows, because the moss from the woods contains too many insects. I also lay under the gills of the fish a thin slice of apple or potato, so as to keep the gill-covers moist and prevent them from becoming pasted together, which would cause the fish to choke. When the weather is very hot I kill the fish and lay them in large ox-bladders between pieces of ice. These bladders I tie securely and pack them in a box filled with damp moss. These boxes I send by mail.

The carp is subject to a species of eruption, caused by the sting of an insect. When suffering from this disease the carp does not look well and does not fetch a good price. For a long time I searched in vain for the cause of this disease, and only three years ago I succeeded in finding it. This disease is caused by the circumstance that after a sudden thaw or violent rain-storm the water feeding the pond becomes very muddy, and this muddy water is the real cause of the eruption. Our ancestors, who engaged in carp culture more than we do, knew this very well; and in all the ancient carp ponds I found at the place of influx a side ditch for the purpose of drawing the turbid water from the pond and carrying it outside of the dikes into the outflow canal.

We have the following kinds of carp: 1. The *common carp* with yellow scales, and the so-called *silver carp* with whitish scales. Both these kinds should be cultivated in muddy, stagnant waters (or sky ponds). 2. The *mirror carp*, for ponds with a rich supply of water. 3. The *Silesian leather carp*, for ponds which are fed not only by river or lake water, but also by spring water. 4. The *Chinese gold carp* (goldfish), which should be placed in the smallest basins of the pits which have been formed near our brick-works. We should not despise any sheet of water, for it is the duty of every intelligent man to utilize every inch of ground. Even these small fish, which so far have only been considered as ornaments, will be of some use.

In conclusion, I have to state that fish-culture is exceedingly remunerative; and that even the most intelligent farmer cannot compete with us. We shall beat him by our results at every step, if we only take care to work unitedly.

18.—METHODS OF PREPARING FISH-BLADDERS FOR MARKET.*

In a former article† directions were given for preparing fish-bladders intended for isinglass or fish-glue. The bladders are also used as an article of food, especially in Spain, Italy, the West Indies, and China, either salted alone or salted and dried. The last-mentioned method of curing it is the same as that employed in preparing klip-fish, either

---

* "*Tilvirkning af Sundmaver.*" From the *Norsk Fiskeritidende*, Vol. V, No. 1, Bergen, January, 1886. Translated from the Danish by HERMAN JACOBSON.

† See F. C. Bulletin, 1885, p. 295.

dry-salting or brine-salting being used. The latter is to be preferred under all circumstances, as it produces a thicker and heavier article.

As in all products of the fisheries, it is of the greatest importance that the raw material should be fresh, as stale fish will produce a dark article of second-rate quality. If the bladders of such fish are used they should be salted by themselves, but on the whole it is advisable not to use them, because the expense of preparing them is so great that it hardly pays. Nothing but fresh bladders should be used, and they should, therefore, be taken from the fish as soon as possible.

In this method of preparing bladders cleanliness and great care are essential for obtaining a good article. The bladder should not be torn out, but should be cut from the backbone with a thin-bladed knife, letting the blade follow the hollow portion of the bone by pressing it with the thumb. In doing this one does not run the risk of having the bone come loose at the same time. A skilled man can cut from 4,200 to 4,400 bladders a day. As soon as the bladder has been separated from the bone, it must be well cleaned and all blood and impurities removed, which are found especially on the inside. If time allows it, both the black skin on the outside and the white skin on the inside should be removed. By doing this, a whiter article is obtained than if this process is deferred until the bladder has lain in brine. After it has been well cleaned it is laid over night in sea-water, which gives it a whiter color. The following day the bladders are salted, after they have been well rinsed and the water has been allowed to run off. The salting is done in tubs, which should not be tight, if dry-salting is used. In either case—whether dry-salting or brine-salting is used—at least one-fourth barrel of salt is used, rather too much than too little, as there is no danger of the bladders becoming too strongly salted ("burnt"), even if they are buried deep in the salt. Generally white and clean common Liverpool salt is used. When salted, bladders will keep for a long time, often for several months. They should, however, be looked after from time to time. As soon as there is the slightest indication of their "souring," the old brine should be changed for new and strong brine; or if dry-salting is used, the bladders should be salted over again. In the first case, the bladders should be relaid; and in both cases they should be well rinsed in strong brine.

If there has been no chance to remove the skins while the bladders are fresh, they can be scraped off as circumstances will allow. This is the most important part of the preparation, as the looks of the bladders when dried depend very much on the manner in which they have been scraped. The scraping, for which a common sharp knife is used, should be done very carefully, so that not a particle of the skin remains, while on the other hand great care should be taken not to scrape a hole in them. By soaking them in water the skins come off more easily; but this process should not be employed under any circumstances. If the bladders cannot be dried immediately after having been scraped,

they should again be laid in strong fresh brine, in which they can remain for several months without being injured.

When the drying process is to begin, the bladders are first laid in heaps on specially-arranged frames, so that the brine can run off. When the bladders are taken off the frames, they are well rinsed, best in new, pure, and strong brine. Each bladder is thereupon well spread out, smoothed down with the hand, and laid on shelves, which are arranged one above the other, about 7 inches apart. Instead of the shelves, frames may be used, about 8 feet long and 3 feet broad, covered with net-work, the meshes being the same size as those of mackerel nets. The frame itself is formed by laths about 2 inches thick, slightly bent, so the air can circulate freely, when one frame is placed above the other. Frames are preferable to shelves, as the bladders are exposed to a current of air on both sides,* and as they dry better. When one has gone so far that the drying process is carried on out-of-doors, the bladders may simply be placed on the drying pile; while if shelves are used they must be spread out. In case of rain they can quickly be brought under shelter or be piled one above the other, and the whole covered with tarpaulins.

The first drying process should be carried on under shelter in a shed having doors opening south and east. The bladders cannot yet stand the sunshine, because, when exposed to it in the beginning of the drying process, they easily assume a yellowish color, which makes them a second-rate article. They are left on the frames or shelves until they begin to dry on the outside. After several days a crust forms on them, which can easily be ascertained by passing the hand over them. They are then laid in common Havana boxes, carefully spreading them out and smoothing them. They should rise about one-third of the height of the box over its upper edge. Four to five boxes are then placed one above the other, so that they may be suitably pressed. During the pressing, which lasts from five to seven days, the position of the boxes is changed every day, so the lower ones get at the top, and vice versa, so that each box receives the same amount of pressure. No rule can be laid down to determine when they are sufficiently pressed, as nothing but experience can teach this.

When the bladders appear to have been sufficiently pressed, the drying in the open air begins, during which either the frames referred to above are used or the bladders are carefully spread out on the rocks. The drying goes on gradually, alternating with pressing and stretching, so that the bladders do not lose their smooth appearance. As soon as they begin to shrivel in the sun they should be taken in and placed in boxes, by layers if possible, some weight being put on the top. The same should be done every evening. If the drying process has been

* When shelves are used, the bladders need not be turned, as they slightly shrivel when beginning to dry, so that the air can strike their lower sides.

very rapid, they should in the evening be placed in a press, and left in it until they have resumed their smooth appearance. It may be laid down as a general rule that the drying process should never be forced, but occupy from four to five weeks. The bladders should be protected against rain, as rain-drops cause spots, which make them a second-class article.

When the bladders, by being pressed hard, do not leave any spots, they may be considered completely dry, and can keep for years. Thoroughly dried bladders are not apt to mold. The main points aimed at are to give them a smooth, even appearance, and a pure, white color, without spots, which can be reached by a thorough and careful treatment. The preparation of dried bladders as an article of food, therefore, requires patient labor.

For shipping, the bladders are pressed into wooden boxes or tin cans holding from 6½ to 100 pounds. From a barrel of salted bladders weighing about 264 pounds and containing 4,200 to 4,400 bladders (about 16 bladders to a pound), from 100 to 110 pounds of dried bladders are obtained, that is, from 37½ to 41⅝ per cent.

Capt. J. W. Collins* gives the following statement of weights: One thousand pounds of round cod yield from 9 to 10 pounds of bladders. When scraped they weigh 6½ pounds; salted, 5¾; and when dried about 1½ pounds. According to this statement 100 pounds of salt bladders would yield 25 pounds of dried bladders.

During the past six years an average of about 30,000 pounds of fish bladders has been annually exported from Norway, at an average price of about 15 cents per pound. The price, however, fluctuates very much. The average price of a barrel of salt bladders is about $3.22. Captain Collins stated that in 1879 the prices paid at Gloucester were about 4 cents per pound for salted bladders, and from 22 to 35 cents per pound for dried bladders.

According to Mr. Earll, in the United States, bladders are often salted together with tongues, the price being stated at from $8 to $12 per barrel.

In Canada, bladders and tongues are also salted together. The Canadian fishery statistics give the quantities of bladders as follows:

Years.	Quebec.	Nova Scotia.	New Brunswick.	Total.	Value.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	
1878	679	2,604	1,217	4,500	$11,082
1879	396	3,141	1,076	4,613	11,361
1880	113	4,075	1,698	5,886	14,498
1881	396	3,311	793	4,500	11,082
1882	509	3,566	538	4,613	11,361
1883	1,160	3,934	425	5,519	13,591

*See F. C. Report for 1878, p. 703.

In addition to the above, the following quantities of dried bladders were prepared:

Years.	Quantity.	Value.
	Pounds.	
1881	81,400	$77,330
1882	147,400	117,920
1883	114,400	108,680

From Newfoundland there were exported, in 1881, 119 kegs of bladders and tongues, at $1 per keg; and in 1882, 46 barrels, at $3 per barrel. The mode of preparing salt bladders is the same as that of cod in kegs. For both saltings about ⅓ barrel Cadiz salt per barrel of prepared bladders is used. To judge from the small quantities prepared, there cannot be a very great demand for this article.

In Iceland the bladders are generally salted on board the vessels, either in tubs or in boxes. When they are to be dried, they are first washed in salt water and the black skin is taken off, after which they are strung on hooks and hung around the walls of the house. The general method of preparation followed in Norway is this: The bladders are washed as soon as possible, cleaned of blood and skins, and spread out on frames where there is a good current of air, or on stone fences, but not on the rainy or sunny side. When they have become dry enough to be stiff, so as to keep apart, they are strung on a thread and dried in the wind. If they cannot be dried immediately, they are slightly sprinkled with salt. They should be soaked as soon as possible and dried in the usual manner. This article is of course used only in factories.

In conclusion, an account is given of the method of Rev. Mr. Deinboll,* as it may prove of practical use in the household. It is as follows: After the bladder has been cut from the backbone it is for some time laid in lime-water, so that fatty parts may be removed. Thereupon the outer skin and sinews are scraped off with a knife, the bladder is opened, rinsed well in warm water, and rolled in a linen cloth until it becomes as soft as dough, when it is formed in tablets, sticks, and other figures. A hole is then made in every piece, and they are hung on a string to be dried in a gentle heat, but not in the sun. Others cook the bladders, after they have been cleaned, in water over a slow and even fire until they become a slimy mass, which is cast in molds, in which they remain until cold, when they are rolled out on boards in small leaves, and when these are almost dry they are rolled together like strings.† They should be kept in a dry place, for in the air they easily become damp.

* *Om Behandling og Tilvirkning af Saltvandsfisk.* Christiania, 1839.

† Both methods are used in Russia.

19.—FISH BECOMING BLUE AND RIGID DURING TRANSPORTATION.*

By J. STANGE.

An instance of fish becoming bluish and rigid during transportation has recently happened, which seems to throw some light on the subject.

After the fisheries in one of my carp ponds, located about 1½ hours' journey by wagon from my residence, had come to a close, the carp were put into a large and long barrel, which on the upper side had a square hole measuring 40 centimeters [15¾ inches] in diameter, which is lined with boards 24 centimeters [9½ inches] high; this barrel was placed on the wagon and filled with water up to the edge of the hole. Besides this barrel there was put on the wagon a low tub filled with water and containing two pike. As the weather was rather warm, I told my driver to go fast, which is generally considered advantageous under the circumstances. As the entire length of the road was paved, the water had been spilt out of the low tub, so that the pike touched the bottom. They were lying on their side and did not move, not even when I took them from the tub, with the exception of the eyes and gills, which they moved in a feeble manner. It struck me at once that these pike, instead of a yellowish, had a bluish color. I immediately placed them in a fish-tank, through which passed a current of spring water. The barrel containing the carp was still full of water; the fish were sound and lively.

The next morning the two pike lay on the bottom of the fish-tank. I took them out; their color was still blue; they were not dead, and moved their eyes and gills, but otherwise appeared as if they were paralyzed. The body was flexible, as in sound fish, but had lost the faculty of motion. I again placed the pike in the tank, and examined them every day, but for four days there was no change; the pike remained alive, but the faculty of moving did not return. When I came to the tank on the fifth day, it had been broken open, and the pike unfortuntunately had been stolen.

The rigidity of these two fish had probably been caused by the circumstance that, after most of the water from the tub had been spilt, the fish, by the bumping of the wagon against the stones of the rough pavement, had repeatedly been thrown with their abdomen against the bottom of the tub; and that thereby the body had become rigid. I presume this all the more because the carp in the barrel, which, when it reached its destination, was still full of water, were, without exception, in a normal condition. If fish, during transportation, are to remain sound, they should therefore have plenty of water.

WIK, near KIEL, HOLSTEIN.

* "*Das Blauwerden und Erstarren der Fische beim Transport.*" From the *Deutsche Fischerei-Zeitung*, Vol. VIII, No. 50, Stettin, December 15, 1885. Translated from the German by HERMAN JACOBSON.

Vol. VI, No. 5. Washington, D. C. Apr. 8, 1886.

20.—THE PRESERVATION OF FRESH FISH.

By Prof. J. COSSAR EWART.

[Transmitted to the State Department by the United States consul at Leith.]

The "chemical powder" used by the Norwegians for preserving herring is a mixture of boracic acid and common salt. From our greatest authority in antiseptics I have learned that boracic acid has been used in Norway for at least fourteen years for the preservation of articles of food, &c. Those acquainted with Norway can well understand how necessary it is for the farmers and others who live far removed from the towns—by the margins of the long winding fiords or on the slopes of the great mountains—to provide themselves with various kinds of pickling agents. It seems that boracic acid, after a long trial, has proved a most valuable preservative, chiefly because it keeps fish and other food stuffs in a perfectly fresh condition for several weeks, and, without being hurtful, it often tends to improve the flavor.

Recently a mixture of boracic acid and salt has been used with so great success for preserving herring in a fresh condition that it is now possible for Norwegian herring to compete successfully with absolutely fresh herring in the English market. Thousands of people in England have consumed Norwegian herring a week or more after their capture, believing they were fresh from Yarmouth or some of the great Scottish fishing stations. I need not say that herring rapidly become unfit for food when taken out of the water. In summer they are often useless twenty-four hours after they are captured, and in winter the process of disintegration is not long delayed. What is true of herring is to a great extent true of other fish. Often in summer the fish landed at Newhaven from fishing boats becalmed at sea is almost putrid, and were it thoroughly inspected, as it should be, it would often be at once condemned as unfit for food. It is, as already pointed out, this extreme perishableness that necessitates the rapid dispatch of fresh fish, and affords an excuse for the high rates charged for carriage. Hence the boracic acid will be welcomed as a great boon, if it preserves fish in a fresh condition for several weeks. On learning some time ago that the Norwegians were sending us herring preserved in a chemical powder, I succeeded in getting a sample and had it analyzed. After an elaborate examination, Dr. Atkinson, assistant to the Professor of Materia Medica in the University, reported that the substance submitted to him was a very pure preparation of boracic acid. Mr. David Murray, of Anstruther, who takes a keen and practical interest in all questions

relating to the fish trade, was good enough to pickle several samples of herring according to the Norwegian plan. Some of these samples I have examined with the most satisfactory results. Herring pickled on the 19th of January are as fresh and sweet to-day [January 28?] as they were when introduced into the mixture, and when cooked they can scarcely be distinguished from herring only a few hours out of the water. I understand that equally good results have been obtained by Mr. McCombie, of Peterhead, with haddock.

Let us now indicate how the boracic acid should be applied. For preserving herring, the best plan seems to be to make a mixture of powdered boracic acid and fine salt, taking two pounds of salt to every pound of boracic acid. This mixture having been made, the fresh herring should be arranged in layers in a barrel, in exactly the same way as cured herring are packed, and each tier covered with a thin layer of the mixture. When the barrel is full it should be tightened down in the ordinary way, and then "pickled" with a weak solution of pure boracic acid. For treating a barrel of herring in this manner, 2½ pounds of acid and 5 pounds of salt are required for spreading on the tiers of herring during packing, and about 10 ounces of pure acid for dissolving in the fresh water used for pickling. After further experiments it may be found advisable to alter somewhat the proportions here given. The barrels when packed should be kept in a cool place where there is a nearly constant temperature. The expense of pickling a barrel of herring (a barrel holds from 800 to 1,000 herring) in this way need not be great, for boracic acid can be purchased under 6*d.* per pound. A barrel of herring, which cost originally 8*s.*, might be preserved in boracic acid and delivered in London for 14*s.*; this is supposing the pickling to cost 3*s.* and the carriage 3*s.* If sold for 20*s.* (*i. e.*, three or four for 1*d.*), a considerable margin would be left for profits to the curers and others.

In addition to preserving fish, boracic acid might be of use for preserving fishermen's bait. Often the fishermen (or more often the fisherwomen), at a considerable expenditure of time and money, bait their lines in vain. All arrangements are made for a night's fishing, when a change of weather prevents the boats reaching the fishing ground. Before another night arrives the bait has usually lost its catching powers, and the tedious process of baiting the lines has to be repeated. Whether boracic acid will preserve bait the fishermen only can settle. If at Anstruther, or some other fishing station, two or three fishermen use bait which has been preserved for some days in an equal mixture of salt and boracic acid, and compare its catching power with fresh bait, they will be able to ascertain whether this preservative will in any way lessen their labors. The United States fishermen often have wonderful success when they use frozen herring as bait; the herring are usually frozen and exported from Labrador.

It may be hoped this system of treating fresh fish will be useful. It ought at least to enable our curers to compete with Norway, for in ad-

dition to other advantages they have better material to work with, our herring being undoubtedly superior to those taken around the Scandinavian coast; even the Norwegians prefer Scotch-cured herring to their own. Further, if curers preserve herring with boracic acid they will to a great extent be independent of the railway companies; it will no longer be necessary to dispatch fish by express trains, and pay for their carriage two or even three times their value. Whether the herring take a day or a week to reach London, Manchester, and other large towns will make no difference, and in many instances curers may with advantage forward parcels of fish by the ordinary coasting steamers. The saving made by sending fish by sea will be evident when it is stated that it would probably cost less to send a barrel of herring twice round the world by steamer than to send it once from St. Andrews to London by rail. We must, however, not expect too much from boracic acid. Something more will be required before the fishery industry recovers from its present state of collapse and begins to assume the importance it deserves.

When referring to the boracic acid method of preserving fish, I ought to have mentioned that it is enabling Norway to drive Scottish herring out of the English market. Over 20,000 barrels of herring reached England last winter, and nearly 30,000 barrels have arrived during the present winter. The consignments from Norway have reduced the prices so far that a barrel of Scottish herring sometimes scarcely brings enough to pay its carriage to London. This will be better understood when I mention that from most of our fishing stations it costs 75*s.* to send a ton of fresh fish to London. There are five crans (ten barrels) in a ton, hence each cran costs for carriage alone 15*s.* When to this porterage and other charges are added, the large sum of 18*s.* or even 20*s.* may be reached for conveying a cran of herring to Billingsgate. A parcel of herring sent recently from Anstruther to Manchester were sold (as shown by bills of sale in my possession) at 10*s.* per barrel 20*s.* per cran). Each barrel cost for carriage, &c., 7*s.*, which leaves 3*s.* to be divided between the curer and the fishermen; parcels sent to London sometimes yielded little over 1*s.* per barrel, owing to the market being "overdone" with herring from Norway. I am now able to state, from definite information received from Peterhead, that Messrs. McCombie have preserved during January several barrels of haddock and about 1,000 barrels of herring in boracic acid. It must be borne in mind that Norway is not likely to rest satisfied with sending us fresh herring; she is doing her utmost to develop her fisheries, and especially to compete with Scotland in the English market. If this competition leads to the railway companies lowering their rates for fish, and causes our fishing industry to be carried on in a more intelligent and systematic fashion, it will undoubtedly do good. Hitherto the fisheries have been allowed to take care of themselves; we have neither attempted to establish

large fishing stations in the vicinity of the rich fishing banks around Shetland and the Hebrides, nor have we constructed suitable harbors; and we are only beginning to recognize the necessity of providing the fishing stations with telegraphic communication. The fishing industry is to a great extent carried on by men who seldom do more than make a living—not by capitalists who can invest large sums in harbors, boats, &c., and the State, which is virtually the landlord of the fishermen, has not yet fully realized its responsibility in providing such accommodations (harbors) as will admit of their harvest being satisfactorily reaped. It will be admitted that little progress has been made for years towards placing in the markets all over Britain a good supply of cheap fresh fish, and that the curing of herring for exportation (the only branch of the industry which has been energetically carried on) has resulted in all but complete failure, the curers having lost during the last two years nearly a million pounds sterling. This being the case, instead of continuing to cater chiefly for the continental market, we should rather aim at supplying the home market with fresh fish. I am convinced that unless this is done the fishing industry will remain in an unsatisfactory condition, and we shall fail to utilize the latent energy of the Western Highlands and Islands, and deprive ourselves of the riches of the waters which wash our western shores. In order to increase the supply of fresh fish little more than organization is required. It will be necessary (1) for the fisherman to land the fish in good condition, and (2) for the receivers to preserve them by ice or otherwise, and dispatch them rapidly and cheaply to the various centers of population throughout the country. What is absolutely necessary before a step can be taken in the right direction are fast steamers, adapted for carrying fresh fish from the chief fishing stations along the east and west coasts to the southern markets. When lecturing in Fraserburgh last February I ventured to say "that a few swift steam fish-carriers, provided with refrigerators, or simply with pens and ice, would revolutionize the distribution of fish."

Before pointing out in detail what organization is required, I ought, perhaps, to refer to the alleged diminution of the fish shoals around our coast. Suppose we take for granted that the territorial waters (and some of the off-shore banks) that lie between Peterhead and Berwick-on-Tweed no longer yield the takes they did a generation ago, it does not follow that the waters off the coast of Caithness and around the Orkney and Shetland Islands are to a great extent exhausted; far less does it prove the exhaustion of the waters that surround the Hebrides, and flow between them and the mainland. If the banks off the east coast are beginning to fail, it should be remembered the signs of failure are only appearing after many abundant harvests have been reaped, and that even now they yield weekly many tons of fish. If fish are still captured—sometimes in large quantities—in waters over which fishing vessels have sailed for centuries, how much more likely

are they to be taken in the waters around the Northern and Western Islands, which are relatively as rich as the unplowed prairies of the Far West! It may be said that large fishing fleets visit Barra and Stornoway and other stations on the west coast every summer, and that fishermen are constantly at work around the Orkney and Shetland Islands. It ought, however, to be remembered that the only fishing of any note around the Western Islands lasts but eight or ten weeks, and that nearly all the fisherman are in search of herring, to be cured for the foreign market. During the rest of the year comparatively little fishing is carried on, so that the shoals of cod, ling, and halibut are practically undisturbed. At Shetland, however, in addition to the summer herring fishing, there are a number of boats engaged in capturing cod, halibut, turbot, &c., which are sent in ice to the English markets. But it is well known that the fresh fish now sent (under 500 tons in 1884) from Shetland do not represent a tithe of that which the waters, if more thoroughly fished, would readily yield.

It may be asked, how is it that the fisheries of Shetland and the Western Islands have not assumed greater magnitude? For two reasons, I think. In the first place, because the curers, in whose hands the development of the fishery industry to a great extent lies, have practically devoted their whole attention to curing herring for the continental markets; and in the second place, because the native fishermen of the Western Highlands and Islands have had little encouragement to engage in fishing. In the absence of appliances for preserving fresh fish, and without fast steamers to carry them to Liverpool and other large towns, fishing could not possibly pay, even if suitable harbors and large boats were provided. As an illustration of this, it may be mentioned that large turbot, which could not be purchased under 20*s.* or 30*s.* in London, are often cut into slices, and used as bait in the Hebrides. The present condition of the fishing industry in the northwest of Scotland is due to the unfavorable surroundings of the inhabitants rather than to anything connected with national characteristics. It might be pointed out that on the west coast of Norway (where the inhabitants have in some respects fewer natural advantages than the west coast of Scotland can boast of) there is the large town of Hammerfest, within the arctic circle, further south is Trondhjem, and nearly opposite Lerwick, in Shetland, is the old busy town of Bergen, with a latitude of 60.23 degrees—nearly 120 miles north of the Butt of Lewis, and twice that distance north of Barra. Bergen, which has about 35,000 inhabitants, is one of the chief towns in Norway, and is the great center of the fishing industry. How is it that there is not in Lewis Island and still more in the Shetlands a town of the same importance as Bergen, with a large fishing fleet and numerous trading vessels passing to and fro? Some might point to the difference of the two races, and endeavor to show that the absence of prosperity in the north and west of Scotland was due to the predominance of the Celt, while the success on

the west of Norway resulted from the indomitable perseverance of the hardy Norseman. This may be partly true, but it should be remembered the inhabitants of Shetland and of the north and east portion of the Long Island are as nearly pure Scandinavians as are the inhabitants of Bergen and other towns on the west of Norway; and, further, that the fishermen in Lochfyne, who are pure Celts, are as energetic as they are hardy and prosperous. As far as I can judge, the conditions on the two seaboards have been entirely different. Putting aside the traditions inherited from the time of the vikings, the Norwegians have long had a direct interest in the soil, and an excellent service of boats around the coasts. By being to a great extent their own landlords, and by reaping all the advantages of their labors, they have come to treat their barren mountain sides in much the same spirit as the Italian cultivates his vine-clad hills. But (what is of more importance from our point of view) owing to the all but impassable nature of the inland districts and the absence of railways, a wonderfully complete system of communication has been established around the coast, which has fostered the fisheries and led many of the natives to devote their undivided attention to reaping the harvest of the sea. But Bergen is not entirely the product of the Scandinavians. Its commercial importance resulted to a great extent from the influence of the Hanseatic League which, during the sixteenth century, monopolized the whole of the trade along the west coast of Norway. Nothing could be more encouraging than the manly way in which the fishermen in certain parts of the Lewis struggle against their hard lot. In the absence of harbors they must rest satisfied with boats that can readily be beached. In these small boats they often brave the full force of the Atlantic, and return from their fishing expeditions knowing that but small recompense can be obtained for their labor, and grateful if, in the absence of harbors, they escape having to drag their boat ashore through an angry surf. The want of success for generations has had a depressing effect, but this would, to the benefit of all concerned, undoubtedly disappear if a Hanseatic-like League was to carry capital and organization into the Hebrides.

Let me now conclude by stating shortly what is required before an abundant supply of fresh fish can be placed in the market. Nothing need be said now about fishing boats; they have been gradually increasing in size, and they will continue to increase until we are able to send, if desirable, a large fleet to take part in the Faröe, Iceland, and Lofoden fisheries. This increase in size will go hand in hand with the increase in number of deep-water harbors. Unfortunately the harbor question is in an extremely unsatisfactory condition. Many of the existing harbors want improving and extending, and there are many fishing villages around the coast that have been struggling for harbors for years in vain. Some villages on the east coast that once had flourishing curing establishments are (for want of harbors for the large boats now required) becoming poorer and poorer, and unless harbors are built the

fishermen must either remove to ports with good harbors or starve. The harbor question must be considered as a national one. Even if the State is unable to grant large sums to build harbors, it ought, in addition to lending at a small rate of interest, to ascertain which of the fishing harbors ought to be extended, and where new harbors should be erected, the position of the fishing banks, abundance of bait, &c., determining to a certain extent the sites. This information could, perhaps, best be obtained by means of a small committee of experts as suggested by the harbor committee which recently reported—the committee to include some one able to advise as to the value of the fishing grounds in the vicinity of the proposed harbors. Given suitable harbors and all the necessary appliances for capturing and landing fish at the fishing stations, the question then arises as to how the fish are to be conveyed to the consumers. If we take Shetland, for example, I would suggest that at the outset a large station be formed, provided with stores, in which fresh fish could be packed in ice or other preservatives, and, if necessary, frozen—where, in fact, by icing, freezing, or other means fish could be maintained in a perfectly fresh condition until placed on board the fish-carriers. In addition to the one large station in Shetland it would be necessary to have a number of small ones, from which the fish could be sent in ice or other preservative to the large station by small steamers or otherwise. From the central station the steam fish-carriers should run two or three times a week, taking in or leaving consignments on the way until London or some port on the east coast of England is reached. Each steamer would, in all probability, require to be provided with a refrigerator in order to preserve the fish. The steam fish-carriers on the east coast might call on the way south at one or more points in Shetland and Orkney, at Wick, Buckie, Fraserburgh, Peterhead, Aberdeen, Montrose, Anstruther, Eyemouth, and Berwick for parcels of fish, and leave them at various ports along the English coast as they proceeded on their way to London.

The Orkney Islands would require at least one central station, and similar stations might be formed at all the fishing centers called at. On the west coast, stations might be formed at Stornoway (perhaps later at Ness and Port-na-Gurin), Gairloch, Bracadale, Loch Boisdale, Castle Bay, and Tiree. Fish could, if necessary, be carried from the smaller stations in the vicinity of these ports by means of small steamers. From the stations named, and perhaps from others in addition, steamers would carry fresh fish to Liverpool and other ports on the west coast. The managers of the various stations on both coasts might be in direct communication with fish salesmen and, if possible, with fish retailers throughout the country, so that few middlemen would be required.

As soon as the fishermen on the west coast were assured that their fish, by being carried regularly to market, would bring fair returns, they would devote themselves to their calling with renewed energy, and

the whole fishing industry would take a new lease of life. As a natural result of the formation of large fishing stations, the refuse of the fisheries would be utilized for the formation of fertilizing agents, oils, &c., and thus lead to a considerable increase in the annual value of the industry. There probably never has been a time when there was greater necessity for energetic action being taken, and everything points to the present time as being especially favorable for a new departure being made in the development of our fisheries.

My previous communications on this subject called forth a number of letters. Some of the writers, naturally enough, were anxious to be assured of the safety of the "chemical powder" recommended, while others contributed exceedingly valuable information. One writer endeavored to point out not only that boracic acid was a poison, but also that it was a cumulative poison. The all but universal creed of our fishermen is, "What our fathers did, that shall we also do." This being so, the advice to stand still is little needed; and in this case it might have done injury had Professor Hay, of Aberdeen, not come to the rescue. On the subject of the physiological action of salts we have few authorities equal to Dr. Hay; hence, when he tells us that he is "satisfied that no one needs fear any bad effects from the eating of fish preserved by the Norwegian method," we may consider the matter as settled. Dr. Hay pointed out that 90 grains of boracic acid have been taken daily for weeks without producing any bad effects, and, further, that in some cases when from 30 to 50 grains were taken daily with the food, the appetite and the weight increased, and the general nutrition was improved. As a matter of fact, boracic acid is practically as safe as common salt, and the only evil likely to result from taking, say, half an ounce of boracic acid, is a slight disturbance of digestion. I have known men return from Norway in excellent health, who, in the absence of other food, subsisted for months almost entirely on fish preserved in boracic acid. If ninety grains of boracic acid can be taken daily with impunity for weeks, and if half an ounce causes only slight indigestion, there is little chance of any harm resulting from the small quantities stored up in the tissues of fish preserved in a mixture of boracic acid and salt. Professor Hay thought that in all probability only 2 or 3 grains would penetrate into the substance of a herring left from ten to fourteen days in the mixture. This conjecture was verified by Mr. Miller, of Wick, who found that herring preserved from the 2d to the 11th of February contained on an average 3 grains each of the acid. Similar results were obtained by Dr. Aitken, who examined, at my request, two herring which had lain in the acid and salt mixture for three weeks. The two herring (which together weighed 279 grams) were steeped in water and then boiled. The water in which they were steeped contained 0.368 gram of boracic acid, the boiled water contained 0.594 gram of boracic acid, and the flesh when analyzed was found

to contain 0.348 gram of boracic acid. The total amount of boracic acid in the two herring was therefore 1.310 grams, equal to about 20 grains. Three-fourths of this acid was extracted by cooking (the acid being more soluble in hot than in cold water), so that only about 5 grains were left in the tissues likely to be eaten, or about 2½ grains in each herring. This being the case, judging from the experiments referred to above, three dozen herring preserved in boracic acid might be eaten daily for months without any injury resulting from the *acid* taken along with them. I ventured originally to call attention to the use of boracic acid as a preserving agent in order, if possible, to enable the herring taken off the Scottish coast to compete successfully in the English markets with those sent from Norway. Hitherto, owing to the perishable nature of herring, it has been necessary to send them by fast passenger trains, which necessitates a high rate for carriage. For the same reason it has been necessary, however large the take, to throw the whole at once into the market, even when the supply far exceeded the demand. By a careful use of a mixture of boracic acid and salt it is possible, with a fairly low temperature, to keep herring and other small fish perfectly fresh for several days—long enough to allow their being sent by slow trains, and to admit of the supply being regulated by the demand, and prevent prices fluctuating from 2*s*. or 3*s*. one week to 20*s*. or 30*s*. the next. Boracic acid has, however, many other uses than this. If a curer has more fish on hand than he can sell profitably in a fresh state, by using boracic acid he can preserve them until he has an opportunity of smoking or drying them. Herring that have been preserved in boracic acid make excellent bloaters. Haddock, in the same way, when split can be preserved for a considerable time in boracic acid before they are converted into "findons." Cod and ling may also be treated advantageously with boracic acid before they are dried. The millions of dried cod found in the Bergen stores are all (as the ancient and fish-like smell indicates) undergoing, however slowly, putrefactive changes. This would, to a great extent, be prevented if boracic acid was used during the early stages of curing.

None of the methods above referred to, however, absolutely arrest putrefaction. They fail in two important respects. In the first place, the organisms already in and on the fish are not completely destroyed; and, in the second place, no effective steps are taken to prevent the entrance of new organisms. At the best, it can only be said that most of the original organisms are killed, while the tissues of the fish are rendered more or less unsuitable for nourishing the surviving germs and the new organisms that may be introduced.

In preserving fish, flesh, vegetables, &c., the battle is with invisible but ever-present organisms, which, as they live and multiply, break up the organic molecules of which the tissues are composed, and lead to the formation of noxious by-products. This breaking up of the tissues we call putrefaction. Just as the yeast plant, by breaking up grape

sugar, sets up fermentation, and gives rise to by-products (alcohol and carbonic acid), so bacteria, by breaking up the muscles of the fish, &c., set up putrefaction, and lead to the formation of by-products—sometimes harmless, sometimes extremely poisonous. With the organisms of putrefaction surgeons and food-preservers have long waged war. The surgeon at last has won the victory by means of Lister's antiseptic system; the food-preserver, guided by the discoveries of Pasteur and Lister, has also been successful to a very large extent. In some cases, after arresting putrefaction by boiling, he prevents the germ-laden air entering by hermetically sealing; in other cases he arrests putrefaction by the use of ice. How may we further extend antiseptics to the preservation of fish? A surgeon, in order to render a wound aseptic, first endeavors to destroy all the organisms that exist in the disintegrated tissues, and then does his best to prevent the entrance of new organisms or their germs from the atmosphere. The antiseptic fish-preserver must, as far as possible, proceed on the same principle; he must get rid of the organisms that exist in and on the fish when it reaches his hands, and either render the tissues unfit for the growth of a new crop of organisms, or prevent the organisms reaching the tissues. For hundreds of years fish-curers have endeavored to render the tissues of fish unsuitable for the growth of organisms by saturating them with salt. Those acquainted with the process adopted for the curing of herring know how primitive it is. Not only is the flesh rendered less nutritive, but the delicious flavor of the fresh fish is completely lost, and the delicate albumens are decomposed. So much is this the case that there is practically no sale for salted herring in this country; they are in demand only on the Continent, where fresh fish are scarcely known. When lecturing at Fraserburgh last winter I directed the attention of the curers there to a process of curing herring invented some years ago by Mr. Sahlström. Mr. Sahlström's process, first tested in Norway, has been recently carried out in Aberdeen. It consists first in driving out the air from the newly-caught fish, and next in saturating the tissues with a preservative solution. The fish are introduced into a closed cylinder, and there subjected to a pressure sufficient to drive out the air. Into this cylinder the preservative solution is then introduced, and, by applying a pressure of from 60 to 100 pounds to the square inch, it is forced into all the tissues. The fish can be either slightly or completely salted, and either pure salt or a mixture of salt and boracic acid can be used. This method requires fewer hours for curing herring than the ordinary method requires weeks, and, owing to the tissues being thoroughly penetrated by the preserving fluid, they are rendered quite incapable of forming a suitable soil for the growth of organisms. Herring cured in this way can be exposed to the air for weeks without deteriorating in value or losing their original flavor and freshness. Another way of treating fish antiseptically is by Roosen's method. This plan is at present under trial here for the preservation

of salmon. Experiments made in Norway and elsewhere have shown that fish can be kept in a perfectly fresh condition by the Roosen process for an indefinite time without any steps having been taken to get rid of the infected air. The fish are introduced into a steel barrel containing a solution of salt and boracic acid. The cask, after being completely filled with the solution, is sealed, and a pressure of from 60 to 90 pounds to the square inch is maintained until the fish are required for use. Large fish preserved in this way are said to remain fresh for several days after being removed from the liquid. Herring might be kept for a time under pressure at the fishing station, and then forwarded in ordinary barrels to Billingsgate and other markets. Further, all the necessary preserving appliances can be carried on board the fishing boats. A boat provided with the Normal Company's (Sahlström's) appliances could cure at sea large parcels of herring and other fish, and carry them (or send them by fish-carriers) direct to either home or foreign fish-markets. Sahlström's process, it should be remembered, admits of fish being either simply treated with common salt or with a mixture of salt and boracic or some other acid. [From the Scotsman, Edinburgh, Scotland, January 29, February 2, and March 9, 1886.]

21.—SCARCITY OF COD AND HADDOCK ON THE COAST OF MAINE.

By N. V. TIBBETTS.

[Letter to Prof. S. F. Baird.]

I resided for fifteen years, from 1855 to 1870, near the coast of Maine. Most all farmers, like myself, were fishermen at times, and relied on catching our yearly supply of fish of various kinds, especially codfish and haddock; but these fish have long since deserted Penobscot Bay and Eggemoggin Reach, and few are left but young herring, which are caught and converted into "sardines."

If the fish do not come back themselves, and it is evident from their long absence that they will not, the fishermen and farmers along our coast must look to you to coax them back or give us a new supply. If you will do so we will try to have a law passed, if there is not one already, that may protect them from being driven away by the fishermen, as the original supply was. In my opinion, the reason why the fish left our shores was because the fishermen took to using troll-lines. Some say the steamboat was the cause, but I don't think that is so. Codfish know no more what is going on at the surface than we know about the bottom. I have caught haddock and cod where the steamboat had been over the water every day for years, and in not over ten fathoms of water at that.

We used to row out on the Reach two or three hundred yards from shore, and in a few hours were as sure of catching a few hundred pounds

of haddock and some cod as we were sure to find potatoes by pulling up the tops and digging where we had planted the seed in the spring. But after two or three years of using the troll-lines, leaving the fish to die on the hook at the bottom, a man might as well stay at home and fish for haddock in the well—he would catch just as many; but the trollers at that time, I remember, claimed that the steamboats drove the fish out of our Reach.

I have faith that you can help us out of our present trouble, and restore, in a measure, the supply of cod and haddock along our coast. Please inform me what steps are necessary to procure a number of young fish for Eggemoggin Reach, in Hancock County, Maine. Haddock were the fish that mostly frequented that place. Can young haddock be procured from your hatchery at Wood's Holl, Mass.?

BROOKLIN, ME., *February* 27, 1886.

REPLY OF PROFESSOR BAIRD.

I have read with much interest your letter relating to the abundance and disappearance of fish in Penobscot Bay. It is a very difficult matter to say positively what has been the most potent of the many causes for the disappearance of fish from their accustomed haunts. I think, however, I can answer with some certainty that it is within our power, by means of artificial propagation, to restock waters and re-establish such fish as cod and haddock in localities where they formerly abounded. From the experiments which have already been made, it can be asserted with considerable confidence that a school of cod may be established in any given locality by constant deposits of fish produced by artificial means.

I trust that, in the course of time, we shall be enabled to extend the work now being carried on at Wood's Holl and Gloucester, all along the coast of the Northeastern States.

WASHINGTON, D. C., *March* 2, 1886.

22.—NOTES ON THE FISHERIES OF PENSACOLA, FLA.

By SILAS STEARNS.

The fishing business of Pensacola has been more extensive during the year 1885 than at any time before. The first of the year found an unusually large fleet of well equipped vessels at work in the red-snapper fishery. One schooner of the fleet was a Portland, Me., mackerel catcher, with a crew of sixteen men, and several others were recent purchases from New England, with large Yankee crews. The outfit of all the vessels had been improved, and it can justly be said that no better equipped fishing fleet existed anywhere. The most competent skippers that could be found were employed, and under their direction some methods new to

this section, such as trawling, were thoroughly tested and found to be of no advantage.

The weather throughout the winter was unusually bad, as there was a succession of hard blows. The Northern fishermen complained that our weather was nearly as severe as that of their own coast, and that the short, choppy seas of the Gulf were more troublesome than the long, regular roll of the Atlantic. The large schooner from Portland did not appear to have any advantage over the smaller home vessels, and she did not land as many fish as some of them did. Several of the latter made good fares all winter; but the majority of the fleet, especially the small well-smacks, did not make any money.

The larger part of the fish caught came from comparatively a slightly fished ground, about 215 miles southeasterly from Pensacola. The older grounds, from Pensacola to Cape San Blas, did not yield any good fishing. The necessity of going so far for fish increased their cost and made them of less value on account of their being so much longer kept in the vessels. Instead of taking one week, the trips were lengthened to two weeks, which makes quite a difference to the outfitters, who pay the wages of the crews. It is an open question whether the fish have been driven from the adjacent grounds by severe weather or have been in a degree exhausted. It could hardly have been because of not having suitable bait, for at that time there was a good supply of the several kinds that snappers usually prefer. The explorations of the Albatross, made upon the most noted grounds during the milder weather of spring, would suggest that the fish had gone from the grounds.

In spite of the boisterous season the larger number of vessels brought the catch to a much greater amount than that of any former season. In the latter part of the winter one new fishing firm was established.

The prices paid the fishermen remained at the same figures as before; the selling prices were also kept up. The demand after the 1st of January, when the Western lakes were frozen, was moderately good, but showed a falling off from the year before. At the end of the lenten season the red-snapper fleet was reduced from twenty to twelve vessels, the majority of the Northern men going home. The run of shore fish was delayed about a month by the unusually cold weather; and when it did take place almost every point had been fully supplied from either Cedar Key or Tampa.

Spanish mackerel came on the coast in great numbers, exceeding anything known for many years; but there was little demand for them, and no good profit was realized on those sold. Pompanos were not so plentiful as usual, and were not in much demand, as Cedar Key had a large run much earlier in the season. Bluefish came during the last of April, after the mackerel and pompanos, and in no great abundance.

During the summer about a dozen snapper fishing vessels were run with small crews and with orders to bring in limited quantities. The

demand was very light. Fish seemed to be abundant, although not so much so as in former seasons.

During the early fall they were brought in in such quantities as to glut the market. It was expected that the demand in the interior would be very good, but such hopes were not realized. The comparative failure of the staple crops throughout the South, and the general stagnation of business everywhere, made the disposal of fish very difficult.

There was a very large run of bluefish on the coast for several weeks in the fall, and the larger ones of 2 and 2½ pounds weight found ready sale, while the smaller ones were salted for snapper bait. Other shore fish were not abundant.

When the red-snapper fishing was at its best a fleet of 8 large schooners appeared from the North to take part in it. The outlook for them was so discouraging that they were at first inclined to return, and one of them did go to Savannah; but upon getting offers for their fish at a low figure they decided to remain. The result shows that they would have done better to go, or not to come in the first place, as they have done so little that they are still in debt for their outfits at home, and some still owe for their outfits of ice and bait here. Directly after their arrival the weather became so severe that they could not fish or remain at sea, and after it became milder they could not find fish. Nearly every vessel in the fleet failed to pay her bills, and the owners are glad in case no serious damage was done to the vessel. It is a curious fact that nearly every one of the large schooners sustained damage of some sort, while the home fleet of smaller craft endured much hard usage unscathed. The trouble at this date is not so much from bad weather as because there seems to be no body of fish on any of the grounds, even on the far-off ones, so successfully resorted to last winter. Occasionally a vessel finds a little spot where she secures a moderate fare, but such occurrences are uncommon.

The buying price of snappers has remained stationary, while the selling price, even in times of the greatest scarcity, has been extremely low (in fact, hardly above cost), on account of unreasonable competition among the dealers. The demand is good throughout the West and North, the South buying but a small proportion.

The shore fisheries of Cedar Key during the past year have been fairly successful, although the dealers there, as everywhere else, found but a light demand. The spring season's business was unusually good at Cedar Key and Tampa; the fall business was rather poor.

Salted mullets found slow sale everywhere, and almost everybody handling them has been obliged to hold over a considerable quantity. The Key West fisheries of all kinds have not been profitable, and outside of the sponge fishery there has been but little activity.

The shore fisheries on the Louisiana coast have about maintained their usual importance.

PENSACOLA, FLA., *February* 20, 1886.

23.—NEW ENGLAND FISHERIES IN FEBRUARY, 1886.

By W. A. WILCOX.

During the first week in February the weather was unfavorable for fishing, yet the few arrivals brought good fares. During the week the schooner Carrie D. Allen, of Provincetown, the only three-masted vessel in the mackerel fisheries, sailed for Lisbon, Portugal, having been sold to parties there to engage in the Grand Banks cod fisheries. She took out 2,950 quintals of codfish, 2,000 quintals of which came from the Provinces, and 950 quintals were bought at Provincetown.

The codfish fleet fishing in Ipswich Bay number 17 sail of gill-netters and 30 sail of trawlers; and the catch has been of good size, averaging 23 pounds each; one-third being female fish mostly with spawn. The amount of codfish landed at Rockport and Portsmouth during the first week by 17 sail of netters was 204,000 pounds; by 30 sail of trawlers, 600,000 pounds. A much smaller number are at present using gill-nets, on account of the damage and losses by the severe storms of late, but those that are using them are doing well. Cod and haddock are abundant on George's Bank. All vessels from there bring in also a considerable amount of halibut. A large body of fine codfish is also found in Ipswich Bay. A large fleet, mostly from Gloucester, has been engaged in these fisheries, and the vessels have secured good fares quickly and returned.

On February 11, fifty-two sail, mostly from George's, arrived at Boston with over 2,000,000 pounds of fresh cod and haddock. Seldom, if ever, had as much fresh ground-fish arrived during 24 hours. With the large receipts, prices fell from $2.50 to 60 cents per 100. Twenty-four sail also arrived at Gloucester from the same fishing-grounds, landing 700,000 pounds of salt codfish. The heaviest rain-storm for years came about the middle of the month, over 6 inches falling during 48 hours. During the storm the schooner Lizzie H. Haskell, of Gloucester, returning from a haddock trip on George's, went ashore on Plum Island and soon went to pieces. The schooner Mary E. McDonald, of the same port, returning from Fortune Bay with a cargo of frozen herring, went ashore at Port Jolly, N. S., and soon filled and went to pieces. With the many fishing vessels lost, it is seldom that one is reported as lost by fire; but the record for this month shows one such, the schooner Anna D. She sailed from Gloucester on February 17, the next day arrived on George's, and while the crew were busy baiting their trawls a fire broke out from the forecastle. As the crew were unable to handle it, they soon took to their boats and were picked up by the schooner Clytie, which was fishing near them.

The month closed with little satisfaction to the producers or dealers.

Fish have been plentiful, too much so, the demand being only moderate and prices of all kinds of fish being too low for any profit.

The mackerel fleet are making ready for the season's work, while the almost universal desire is that no mackerel be caught before June, thereby protecting the spawning fish and giving time for the old stock to be worked off and the new to improve in quality; yet, if no prohibitory law is passed, probably nearly as many vessels will engage in the early southern catch as of late years.

The leading receipts at Gloucester during the month as compared with the corresponding month last year show a large increase, being as follows:

Years.	Fares.	Cod.	Halibut.	Haddock.
		Pounds.	*Pounds.*	*Pounds.*
1885	77	1,093,900	310,700	216,000
1886	146	2,143,000	927,800	146,000

Receipts of fish at Gloucester, Mass., in February, 1886.

From—	Fares.	Codfish.	Halibut.	Haddock.	Frozen herring.
		Pounds.	*Pounds.*	*Pounds.*	*Number.*
George's Bank	52	1,365,000	134,800	146,000	
Brown's Bank	6	270,000	24,000		
La Have Bank	5	45,000	58,000		
Grand Banks	21		711,000		
Ipswich Bay, trawl	23	264,000			
Ipswich Bay, nets	16	199,000			
Fortune Bay, Newfoundland	11				4,810,000
Bay of Fundy	12				3,097,000
Total	146	2,143,000	927,800	146,000	7,907,000

24.—A GOOD FISHING GROUND IN THE SOUTH INDIAN OCEAN.

By CHARLES ENDICOTT.

Several years ago I was in a ship bound to China, and one morning we made St. Paul Island, in the South Indian Ocean [latitude 38° 43′ S., longitude 77° 38′ E.]. We sent a boat in and loaded it with fish of a superior quality in a very short time. Here the water is perfectly alive with them. In hauling up one a thousand would follow it to the surface; and I think a vessel could be loaded with them in a very short time, and make the voyage in from six to seven months. In view of the many disasters to our fishermen and the terrible loss of life off the North American coast, I suggest this as a new fishing ground. The suffering and exposure would be much mitigated, and the general dangers would be nothing in comparison to those of the Grand Banks. The time to start would be in the autumn, as in our winter months they would find it summer there and pleasant weather.

SALEM, MASS., *December* 11, 1885.

Vol. VI, No. 6. Washington, D. C. Apr. 8, 1886.

25.—FOREIGN FISHERIES IN 1885.*

The Gaspé fisheries were not so productive as in 1884, as the summer fisheries yielded 66,300, and the autumn fisheries 28,300, in all 94,600 quintals, or 4,805,000 kilograms [about 10,575,000 pounds].

The Newfoundland bank fisheries were very good, while the coast fisheries were below the average.

In Labrador there were good average fisheries. Some of the fish caught were lost in the storm of October 11 to 13, during which about 60 vessels were lost. The total loss of fish was estimated at 3,000,000 kilograms [about 6,600,000 pounds].

The Dundee seal and whale fisheries: Seven vessels were engaged in the Newfoundland fisheries, the yield being 73,390 sealskins and 900 tons of oil; 4 vessels were engaged in the Jan-Mayen fisheries, the yield being 10,750 seals and 41 bottlenoses, producing in all 252 tons of oil; and 12 vessels were engaged in the Davis Strait whale fisheries, catching 28 large whales, 220 narwhals, 200 whitefish, 14 bottlenoses, and 192 walruses, yielding in all 359 tons of oil and 10 tons of whalebone.

The Scotch herring-fisheries yielded about 40,000 crans [about 8,000 tons] less than in 1884, or 100,000 more than in 1883.

The statistics of the Scotch fisheries for the period from 1880 to 1883 are as follows:

Year.	Quantity.	Exported.
	Tons.	*Tons.*
1880	1,473,600	1,009,800
1881	1,111,200	745,900
1882	1,283,000	826,000
1883	1,269,400	890,800

The Lowestoft herring-fisheries began later than usual, the yield being 6,638 loads [about 13,275 tons], against 10,015 in 1884, and 7,765 in 1883. In September and October there were very rich mackerel-fisheries, 120 mackerel selling for from 9 to 18 crowns [$2.41 to $4.82].

The French fisheries: In November and December there were unusually rich herring-fisheries. The Newfoundland cod-fisheries were good, while the Iceland fisheries were below the average. The 90 vessels from Dunkirk brought home only 3,100,000 kilograms [about 6,820,000 pounds], while in 1884 they brought 4,800,000 kilograms [10,560,000]; in 1883, 6,700,000 [14,740,000]; and in 1882, 5,000,000 [11,000,000 pounds].

* "*Udenlandske Fisherier*, 1885." From the *Norsk Fiskeritidende*, Vol. V, No. 1, Bergen, January, 1886. Translated from the Danish by HERMAN JACOBSON.

The sardine-fisheries were small, but better than in 1884. The stock of roe on hand in France is estimated at 13,000 tons.

There were good cod fisheries in the North Sea.

The Dutch herring-fisheries yielded about the same as last year. The following are the statistics for the period of 1881 to 1884:

Year.	Number of vessels.	Total number of fish.		Exported.	
		Plain herring.	Salt herring.	Salt herring.	Smoked herring.
			Tons.	*Tons.*	
1881	407	61,100	198,900	134,600	41,400
1882	406	63,400	240,500	139,500	34,000
1883	409	47,600	235,300	156,300	22,700
1884	466	63,500	339,300	191,000	29,800

The Emden herring-fisheries were carried on by 14 vessels, and yielded 11,925 tons of herring.

The Bohus (Swedish) fisheries yielded 288,000 hectoliters [about 816,000 bushels] of herring, valued at 400,000 crowns [$107,200].

The Iceland cod-fisheries were not very productive, and large fish were particularly scarce.

The fisheries on the Murman coast (Russia): A total number of 2,386 persons visited this coast in order to engage in the fisheries; among these there were 22 women and 416 boys. In all there were 604 persons less than during the previous year. The fisheries did not begin in good earnest till April 18, and were not very productive, the total quantity of salt and dried fish brought to Archangel amounting to 725,207 poods [26,107,452 pounds], against 920,613 poods [33,142,038 pounds] in 1884.

26.—THE NORWEGIAN FISHERIES IN 1885.*

The seal fisheries near Jan-Mayen engaged 22 vessels. The yield was 47,000 young seals and 24,400 old seals, valued in all at 800,000 crowns [$214,400].

The bottlenose fisheries: Number of vessels engaged, 20, including 5 steamers, with an average tonnage of 110 tons. Total number of fish caught, 800.

The Finmark whale-fisheries: Number of vessels, 31; total number of whales caught, 1,287; yielding 4,300 tons oil, 120 tons whalebone, and 2,200 sacks of guano; valued in all at 1,500,000 crowns [$412,000].

The shark and other fisheries near Vardöe: Number of vessels, 35; yield, 6 walruses, 786 seals, 10 polar bears, 30 reindeer, 13,000 cod, 18

* "*Norske Fiskerier*, 1885." From the *Norsk Fiskeritidende*, Vol. V, No. 1, Bergen January, 1886. Translated from the Danish by HERMAN JACOBSON.

bottlenoses, and sharks yielding 2,629 hectoliters [about 7,450 bushels] of liver.

The Polar Sea fisheries near Hammerfest: Number of vessels, 30; yield, 396 walruses, 4,211 small seals, 1,509 large seals, 38 polar bears, 86 reindeer, sharks yielding 2,153 hectoliters [about 6,100 bushels] of liver; total value of the fisheries, 115,956 crowns [$31,076.20].

The Polar Sea fisheries near Tromsöe: Number of vessels, 30; yield, 333 walruses, 2,970 small seals, 1,925 large seals, 12 bottlenoses, 175 whitefish, 44 polar bears, 313 reindeer, and shark yielding 622 hectoliters [about 1,762 bushels] of liver.

The winter cod-fisheries: Total number of fish caught, 57,876,000; of these 36,887,000 were salted, and 20,989,000 were dried. These fish yielded 81,238 hectoliters [about 230,175 bushels] of liver, and 52,492 hectoliters [about 148,725 bushels] of roe.

The Nordland and Tromsöe herring-fisheries: Total yield about 650,000 hectoliters [about 1,841,650 bushels] of herring.

The herring fisheries in the northern Trondhjem district: These fisheries were not very productive, and the fish caught were small.

The herring fisheries in the southern Trondhjem district: These fisheries were not very productive, but the fish caught were larger than those caught in the northern district.

The Romsdal and Bergen fisheries were not very productive.

The Hvalöe fisheries lasted from December 12, 1884, till January 20, 1885, and yielded 70,000 hectoliters [about 198,350 bushels] of herring.

The herring fisheries on the southern coast of Norway began towards the end of November, 1884, and lasted till January 20, 1885, and the number of fish caught was the usual average.

The spring-herring fisheries began during the latter half of November and continued till the first week in March. About 8,500 persons were engaged in these fisheries, and the yield was about 100,000 hectoliters [about 283,000 bushels] of herring.

Seine fisheries near Shetland: One Norwegian vessel with a crew of 14 men and 70 nets engaged in these fisheries, making five trips during the year; the yield was the same as the average yield of the Dutch fisheries during a good year, namely, 870 tons of herring.

The seine fisheries near the Norwegian coast: One vessel engaged in these fisheries from May 26 till June 26, casting the nets in all 24 times. Once no fish were caught, twice three-fourths ton was caught, and the rest of the times from 50 to 250 small, lean herring were taken.

The lobster fisheries were good in the Lister and Mandal districts.

The mackerel fisheries were good everywhere, except in the eastern portion of the Lister and Mandal districts.

The salmon fisheries were unusually good all along the coast of Norway.

BERGEN, NORWAY.

27.—DRYING CODFISH AT BORDEAUX.*

By H. GUNDERSEN.

The method of drying codfish at Bordeaux is the one most suitable to the locality. The process is rapid, occupying only from 2 to 6 days, the outlay of money is slight, and the result is a very good article. The French fish will never keep so well as the Norwegian; but considering the excellent means of communication, the price is much more important, and this is, on the whole, very reasonable. A great advantage of these drying frames is this, that they give fish which have begun to turn a little a better appearance and prevent them from decaying altogether, as they can be cleaned, soaked, and dried again with very little expense.

A sketch of these frames is given in Figs. 1, 2, and 3; where *a a* are laths of pine wood; *b b* are poles of different kinds of wood, rammed into

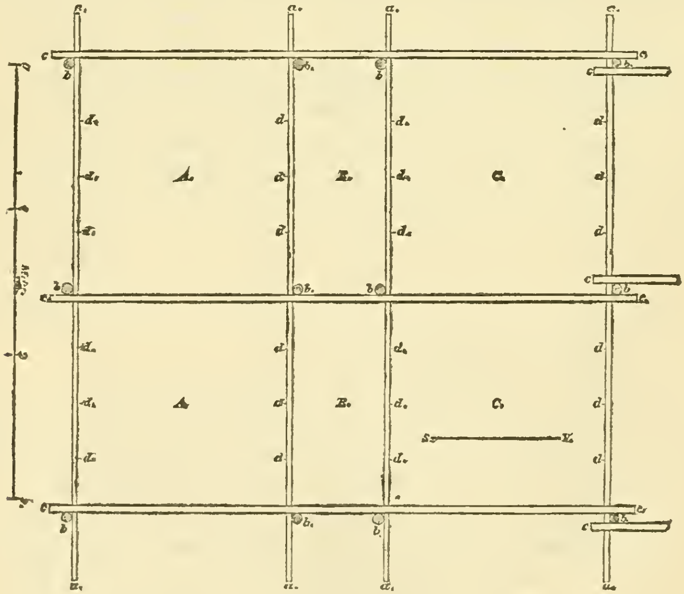


FIG. 1.—Codfish drying frame, top view.

the ground; and *c c* is a cover of strong mats. The fish hang on the laths in rows, exposed to the sun and wind. A temporary roof is generally put on when the rays of the sun become too powerful. There are, however, many drying frames which have no roof. When the rain and

*"*Törring af Klipfisk i Bordeaux.*" From the *Norsk Fiskeritidende*, Vol. V, No. 1, Bergen, January, 1886. Translated from the Danish by HERMAN JACOBSON.

sun become too strong there is then no other way but to take the fish down and lay them in a shed. The fish are not pressed at all.

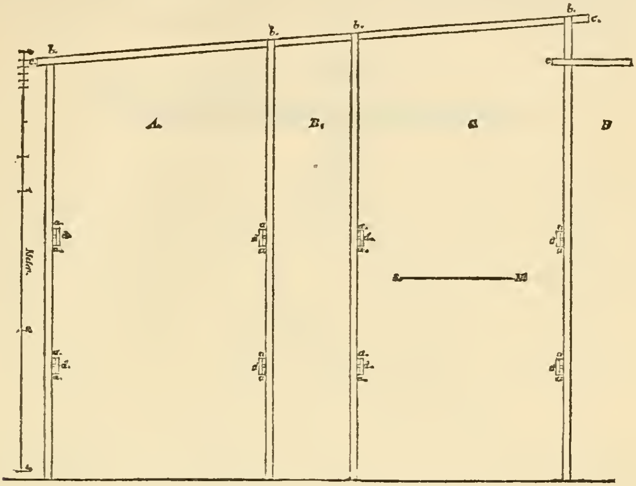


FIG. 2.—Codfish drying frame, side view.

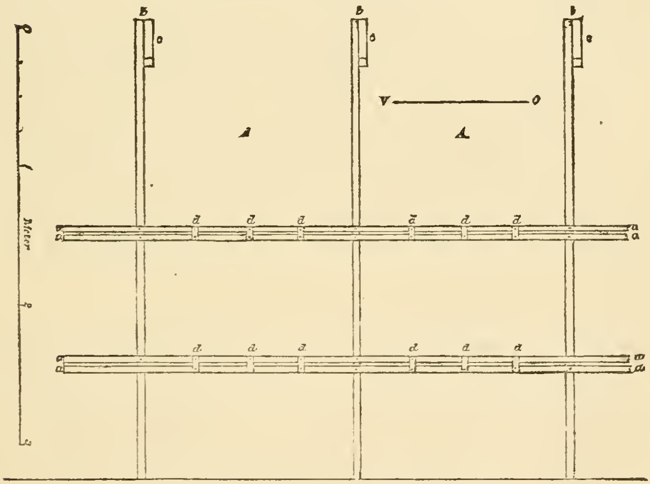


FIG. 3.—Codfish drying frame, end view.

All the drying frames extend from west to east. They vary somewhat in their arrangement, but two types seem to be prevailing: (1) The one given in the illustration, the laths being attached alternately to the north and the south end of the pole; (2) or with an interval of 2½ to 3 meters between all the rows, so that the shadow of one row never falls on another, all the laths being attached to the north side of the pole.

The thickness of the laths is from 1 to 1½ centimeters, and their breadth from 4 to 5. The fish are not specially fastened to the laths, but

simply stuck between them (Fig. 4) from the right and the left (north and south); but the fish are all stuck in with the back upward. By its own weight the fish bends, so that the lower side turns towards the sun.

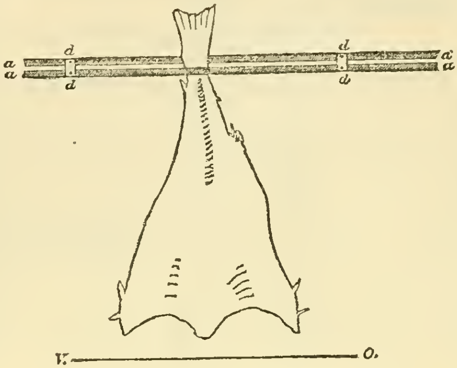


FIG. 4.—Manner of securing fish for drying.

To prevent the laths from giving way and the fish from falling down, blocks of wood (*d d*) are, at short intervals, stuck across every pair of laths. Thereby they are held together so firmly that it would require a pretty strong wind to blow down the fish, even if they have been hung only recently. After the fish have become somewhat dry they hang safely even in a stiff breeze. If the heat of the sun is very strong and there is no straw cover, all that has to be done is to turn the fish so that their edge turns towards the sun. This can be done easily and quickly.

It is not customary to have more than two rows of laths, and in a place like Bordeaux, where there is so much room, there is no necessity for it. The laths generally last from 5 to 7 years, and the poles somewhat longer.

I have made a calculation in order to see what space it would require to dry 30,000 fish, and have found that, counting two rows, and an interval of 2 meters between the rows, it would require an area of 5,624 square meters, or 75 cubic meters; while the same quantity of fish, when dried on rocks, would require an area of 7,344 square meters, or 86 cubic meters. If the interval between the laths is 3 meters, it would require an area of 8,437 square meters. The depth (from north to south) of the French drying frames is 8 meters. On a front of 3 meters 128 fish can be dried; 30,000 would, therefore, require a front of about 700 meters. Owing to the climate, and in view of the fact that a more durable article is to be produced, the drying will take more time in Norway than in France. Hence a layer of earth at the bottom will not prove an advantage. The frames would, therefore, have to be placed on the rocks, which would make them much more expensive.

BERGEN, NORWAY.

28.—HOOD RIVER, OREGON, AS A PLACE FOR SALMON BREEDING.

By E. L. SMITH.

[From a letter to Mr. Livingston Stone.]

I would call your attention to a stream, not mentioned by you in your report on "Salmon Hatching," which may possess some advantages for propagating several varieties of the Salmon family. The stream to which I refer is called Hood River (the Dog River of Dr. Suckley), and falls into the Columbia on the south side, about 23 miles west of The Dalles. This river receives the drainage of the north and east sides of Mount Hood, and is for its entire length, some 30 miles, a rapid mountain torrent, carrying a large body of water nearly equal in volume to that of the Klikitat.

I wish to speak more particularly of the west fork of this stream, which has its source in and forms the outlet of what is known as Lost Lake, a triangular-shaped body of water, some 10 miles due northwest of Mount Hood. This lake is not less than 3 miles in circumference, is very deep, and abounds in mountain trout. About 12 miles from Hood River railroad station this fork unites with the main river. The waters of the west fork are at all seasons clear and cold, while the other branches of Hood River late in summer are colored with volcanic detritus. About 80 rods up the west fork above the main river is a perpendicular fall of about 15 feet, and immediately below the fall is a large circular basin of unknown depth. A few feet below this basin a bold mountain-stream falls into the west fork, falling several hundred feet in a few rods. Salmon, mountain trout, red-spotted salmon trout (*Salmo spectabilis* Girard), and Hood River silver trout find their way in large numbers to the foot of the falls, where their further progress is impeded, except at times of extreme high water. I have fished in many of the streams of Oregon, Washington, and Idaho, as far north as the forty-ninth parallel, as well as in those of Northern Vermont thirty years ago, and have yet to find any stream superior to the west fork of Hood River for the varieties and size of its trout.

Salmo spectabilis are found of very large size, probably 10 pounds or more in weight; but the fish most plentiful is what is known as the Hood River silver trout. This fish enters the river about August, I think, and is found there until the next spring. It resembles a small silver salmon, of the average weight of 2 pounds (though some are much larger), very fat, and most excellent for the table. It is singular that this fish is not found in any of the neighboring streams—the White, Salmon, Klikitat, &c.

It was not supposed that these fish would rise to the fly, but last

September I had excellent sport taking them in that manner. Many were so large as to carry away my tackle at the first onset. It seems to me that they would prove to be a most excellent variety for stocking many small rivers. They are very abundant and full of spawn in August and September.

As to the supply of large salmon in the west fork, I am not certain. On the bank I saw the backbone of one over 3 feet in length; and I saw the salmon jumping in the river, but cannot speak as to the variety or quantity.

With this exception, the locality I speak of possesses every requisite mentioned in your report. With slight improvement the road would be hard and excellent during the entire year. There is abundance of timber on the ground, and water can be conducted, if necessary, 200 feet above the stream. There are no settlers above, and none to interfere below the falls. It is an ideal place for a hatchery for several varieties of trout and salmon, but, as I stated before, I am not certain as to the numbers of the larger salmon. The climate is all that could be desired, with the exception of considerable snow in some winters. With this exception, I think it is as good as any place in Oregon. I would like to see a Government hatchery at that place. When I was at the falls last season the silver trout were trying to jump from the pool to the river above, but all that I saw failed in the attempt and fell back again. Dr. Suckley does not describe this fish in his report.

Eleven years ago I assisted in running the boundary line between Idaho and Washington Territories, from Lewiston north to the forty-ninth parallel, or international boundary. Our line crossed the Pend Oreille in plain sight and a little below the falls you mention, which are about 8 feet in height. Below the falls the river runs slowly for not less than 20 miles, as near as I can judge, before it forms a canyon. The head of the canyon must be some 10 miles below the old Saint Ignatius Mission. At the point of crossing we caught trout and a slender whitefish, but saw no signs of salmon. About the old Mission, now abandoned, were fine meadows of timothy and red-top, but the Indians are not to be trusted.

From the Little Spokane to the Pend Oreille River, following up the first-named stream, is a natural route for a wagon-road. Lake Kaniksu, the waters of which flow into the Pend Oreille above the fall mentioned, is a very beautiful body of water, estimated at 20 miles in length. The Indians have a horse-trail from the old Mission to this lake, where they dry and smoke large quantities of trout. If you have any ambitious tourist in mind who is desirous of exploring unknown lands, I know of no more interesting locality than this lake.

THE DALLES, OREG., *January* 17, 1885.

29.—STATISTICS OF WHALING, COD-FISHING, AND SALMON-PACKING ON THE PACIFIC COAST.

[From the San Francisco Chronicle.]

WHALING.—The following is a statement of the annual catch of the Arctic whaling fleet reporting at San Francisco for twelve years:

Years.	Oil.	Bone.	Ivory.
	Barrels.	*Pounds.*	*Pounds.*
1874	10, 600	86, 300	7, 600
1875	16, 300	157, 000	25, 400
1876	2, 800	8, 800	7, 000
1877	13, 900	139, 600	74, 000
1878	9, 600	73, 300	30, 000
1879	17, 400	127, 500	32, 900
1880	23, 200	339, 000	15, 300
1881	21, 800	354, 500	15, 400
1882	21, 100	316, 600	17, 800
1883	12, 300	160, 200	23, 100
1884	20, 373	295, 700	5, 421
1885	24, 844	451, 068	6, 564
Total	194, 217	2, 509, 568	260, 485

The returns of oil and bone made here for the last year are the largest on record, the entire fleet reporting at this port, while prior to 1879 the greater number of the fleet reported at Honolulu. Until within the last two years the price of whale oil in this market has been from 35 to 40 cents, but owing to the operations of the Pacific Steam Whaling Company the price has been advanced from 50 to 55 cents. This company, having completed extensive refining works here, is now handling a large quantity of the annual catch. The demand for whalebone here is very small, the greater part being shipped east. Two years ago bone was worth $4.50 in New York, the highest price in seventeen years, but has now dropped back to $2.50 per pound.

COD-FISHING.—The cod-fishing fleet of 1885 consisted of twelve vessels, one of which made three round trips, acting as tender for the fleet. The vessels dispatched all arrived back safely, bringing full loads, which has acted unfavorably upon the market, and prices throughout the season have ruled low. The sharp competition of local dealers and the low rates at which superior goods have been sold have practically driven eastern fish out of the market. The last vessel arrived back from the fishing grounds on October 18. The vessels employed in the trade and the catch of each was as follows:

Vessel.	No. of fish.	Vessel.	No. of fish.
Czar (three trips)	286, 000	Constitution	120 000
Arago	50, 000	Tropic Bird	79, 000
John Hancock	64, 000	Francis Alice	35, 000
Dashing Wave	100, 000	San Luis	118, 000
Helen W. Almy	192, 000	Jane A. Falkenburg	120, 000
Isabel	85, 000		

The catch for the past season has been taken from the following sources:

	Number of fish.
Shumagin Islands	620,000
Behring Sea	312,000
Okhotsk Sea	452,000
Total	1,384,000

The cargoes were consigned to the following parties in this city:

	Number of fish.
McCollam Fishing and Trading Company	557,000
Lynde & Hough	469,000
A. Anderson & Co	85,000
N. Bichard	273,000
Total	1,384,000

The catch for the past season was about 235,000 fish less than for 1884. Since the beginning of the cod-fishing industry in 1865 the annual catch has been as follows, that for 1883 being the largest:

Year.	Vessels.	Number of fish.	Year.	Vessels.	Number of fish.	Year.	Vessels.	Number of fish.
1865	7	469,400	1872	5	300,000	1879	13	1,499,000
1866	18	724,000	1873	7	550,000	1880	8	1,206,000
1867	19	943,400	1874	6	381,000	1881	7	1,042,000
1868	10	608,000	1875	7	504,000	1882	12	1,302,000
1869	19	1,032,000	1876	10	758,000	1883	16	1,750,000
1870	21	1,265,500	1877	10	750,000	1884	15	1,619,000
1871	11	772,000	1878	12	1,190,000	1885	12	1,384,000
Total since 1865								20,049,300

SALMON-PACKING.—The California Grocer and Canner makes the following summary of packing operations (in cases) on the Pacific coast for the seasons of 1884 and 1885:

Salmon pack of the Pacific coast.

Locality.	1884.	1885.
Sacramento River	90,000	45,000
Columbia River	656,179	524,530
Eel River	7,500	3,750
Smith River	6,000	1,000
Coquille River	9,560	3,800
Umpqua River	13,320	8,000
Rogue River	9,760	8,300
Chehalis River	4,350	3,400
Puget Sound	15,870	5,000
Fraser River	123,420	87,330
Skeena	17,200	12,800
Naas	4,500	....
Alert Bay	7,400	6,000
Alaska	41,000	67,750
Total	1,006,059	776,660
Barreled salmon:		
Columbia River	....	500
Smith, Eel, and Umpqua Rivers	....	500
Rogue River	....	75
Coquille River	....	250
Fraser River	....	1,000
Alaska	....	2,250
Total	....	4,575

SAN FRANCISCO, CAL., *January* 1, 1886.

30.—EELS IN TANKS AND PONDS.*

The fry of eels can easily be made to grow in closed tanks, but it is best to put in some older eels, *e. g.*, some measuring from 8 to 15 inches in length. An eel-tank should be carefully constructed and should be thoroughly tight. Wooden tanks are best, having a lid with a net-work of steel wire, so that the fish cannot escape. At the top they should have a ledge about a couple of feet broad, with fine sand, and outside of that a tight wall of boards about a yard high.

The quantity of water in such a tank should be about 6 pints to 1 pound of large, live fish, but for fish that are a year old about ten times as much water is needed. The tanks would best be placed in summer in fresh running water, or in a lake, so that the waves may have some influence on the inclosed space. In winter it is best to have the tank in a weak current.

At the bottom of tanks for small eels stones (about the size of a fist) are placed; and over it a coarse cloth is fastened, so the young fish can hide under it. For larger eels there should be at the bottom flat stones, roots of trees, &c., so they can hide. Eels can be fed in these tanks all the year round, but in September a layer of clean sand should be put on the bottom, so that the eels can hide in it in winter.

Eels may be fed on all kinds of animal food, even if it is almost decayed, such as dead animals, entrails, refuse of fish, &c. In the tanks it is best, however, to use fresh food, and to take care that no decaying matter accumulates. From the beginning of October till the middle of April the eels do not take any food, because they are in a state of torpor. But as soon as the eels again begin to take food, they should be fed every other, or at least every third, day at sundown, because the eels generally rest during the day. For young eels the food should be chopped, or it should go through a sausage machine, and be mixed with flour so as to form a dough, then cut in small pieces or rolled out in worm-like strings. Worms, snails, &c., also form good food for eels. Larger eels may be given small shells, such as *Leuciscus rutilus*, &c. When well supplied with food eels will increase in weight from 1½ to 2 pounds in the course of a summer.

Ponds are best adapted to young eels. They will grow well in them; and there are instances that about 3,500 young eels, weighing in all 2½ pounds, which were placed in peat-bogs near Abbeville, France, after five years yielded eels to the weight of 6,000 pounds. Any stagnant water, such as peat-bogs, marl-pits, puddles, &c., may be used as eel ponds, on account of the many insects, larvæ, and different aquatic animals found in them. The only condition is, that these ponds should not freeze to the bottom in winter, or dry out in summer.

* "*Aal i Beholdere og i Damme.*" From the *Norsk Fiskeritidende*, Vol. V, No. 1, Bergen, January, 1886. Translated from the Danish by HERMAN JACOBSON.

Along the banks there should be pits for hidingplaces, and for the same purpose there should be near the banks roots of trees, stones, &c. The steeper the banks of the ponds the less chance will there be for the eels to escape. All channels, either of influx or outflow, should be stopped up, so that the eels cannot escape. Care should be taken that the ponds are never exposed to the danger of inundation.

In this kind of pond eels measuring 2½ to 3 inches in length may be placed, or better yet, eels measuring 8 to 15 inches. These latter are better able to seek their own food, to resist the changes of the weather, and to escape from their enemies. When eels are placed in these ponds in April or May, from 200 to 300 of the smaller size should be counted to an acre of pond area. If the eels are 6 inches long, 50 to 100 should be put into the pond, and of the largest size 25 to 50 per acre.

Many of the young eels placed in a pond are of course lost; some escape, others die, and some are devoured by other fish, frogs, and other aquatic animals; so that one may count on 25 to 30 per cent of the smallest eels (from 2½ to 3 inches) reaching a marketable size; 40 to 50 per cent of the larger (6 inches); and 70 to 80 per cent of the largest. Two thousand young eels weigh about one pound.

In these ponds there should be placed the year after the large eels have been put in, or two years after small eels, a number of shell-fish, say 10 to 15 to every 100 eels. When these begin to propagate, the eggs and the young are an excellent food for the eels.

In spring the eels begin to get hungry, and it will be found an advantage to put into the ponds artificial food, such as manure, or a carcass in a basket, so that larvæ and worms may develop. There may also be a ditch or pit at the bottom of the pond, at one end of which there is placed a wooden box (6 to 10 feet long, 1½ to 2 feet broad and deep) in which the food may be placed. If there is enough food in the ponds, the eels will increase in weight 2 pounds apiece in one year. If eels are placed in good growing ponds for carp, the yield of these ponds may be increased very considerably.

31.—ON THE INTRAOVARIAN GESTATION OF THE REDFISH (SEBASTES MARINUS).

By JOHN A. RYDER.

It has been known for a long time that certain species of *Sebastes* were viviparous. During July last female specimens of *S. marinus* taken by the steamer Albatross off the Banks were found with the ovaries in a gravid condition, but with the embryos in an advanced state of development. These were so far developed as to show all of the features of the end of the lophocercal stage when the median fin folds already contain actinotrichia. Estimating the number roughly, fully one thousand embryos were contained in each ovarian sack.

The individual embryos were slender, about six millimeters long, with a pigmented stripe on the posterior dorsal part of the yelk-sack and along the upper margin of the hinder half of the tail. A large yellowish oil-drop occupies an anterior position in the yelk substance. The caudal part of the tail fold is already widened, as in the embryos of clupeoids, and the end of the straight chorda, as in the latter, divides the tail into very nearly equal dorsal and ventral moieties. The eyes were fully pigmented and black, and what pigment cells were present on other parts of the body were stellate, with several rays running out from a nearly colorless center, in which the nucleus lies embedded.

The only paired fins developed are the pectorals; no traces of the ventrals are yet visible. The proportions of the embryos are nearly those of the clupeoids, the head being but slightly more robust. The majority were found to be coiled up, or with the tail thrown around to one side over the yelk-bag and head, as they lie in the ovary. Each embryo as coiled up formed a flattened oval body nearly one and a half millimeters long and one millimeter wide. Some of these coiled ones seemed also to be covered by an exceedingly thin membrane, which is supposed to represent a zona radiata or egg-membrane. Fragments of this membrane enveloping the embryos when examined under a high power, however, failed to show the presence of fine perforations or pore-canals. These membranes were, moreover, in many instances, adherent to the vascular processes depending from the roof of the ovary, and it is inferred, therefore, that the membranes mentioned are actually the vestiges of a very thin egg-capsule.

The ovary itself was found to have very thin inferior and lateral walls, which were somewhat colored by dark pigment. These thin walls are not concerned in the development of the ova at all; the latter in fact are developed in the thickened dorsal or mesometric side of the ovary, which is highly vascular. When the ovary is opened and the embryos shaken out, it is found that there is an abundant covering of flat, fleshy processes which arise from the roof of the ovarian cavity. The basal part of these processes is thickened, traversed by vessels, and consists largely of ovarian stroma, in which immature eggs are found embedded in various stages of growth. The distal part of the processes which depend into the ovary are subdivided into slender digitations, which dip down amongst the great mass of embryos. These terminal digitations, upon cutting sections of them, are found to be highly vascular; small vessels in fact comprise the greater part of their substance. The vessels which traverse the digitations evidently form long recurrent loops and serve to bring the oxygenated blood of the parent female fish into close relation with the embryos or fœtuses, since these digitations pass down between and amongst the embryos lying in the ovarian bag, in such a way that few of them can escape coming into direct contact with some of the vascular loops in the digitations. The latter also

afford more or less obvious attachment or support to the adjacent embryos by means of the thin structureless membranes already spoken of.

While I have had practically but a single stage of development to study, it is obvious that we have in this instance a very remarkable condition of affairs in the ovary. It is clear, I think, that the method of viviparous development as seen in *Sebastes* is quite different from that observed in other types of viviparous fishes, so that this type adds another to the several forms of development noticed in a paper which I have recently published.*

WASHINGTON, D. C., *March* 27, 1886.

32.—NEW ENGLAND FISHERIES IN MARCH, 1886.

By W. A. WILCOX.

The month came in with the longest and most severe of the many gales during the past winter. The storm began February 25 and continued until March 3. During much of this time the thermometer indicated zero or below, and the wind blew from 50 to 75 miles an hour. One hundred and forty-three sail from Gloucester were absent at this time on cod and halibut trips to George's Bank; and as several days passed with no arrivals or news from them, much anxiety was felt. All at last arrived, mostly more or less damaged. Ten men were lost by being swept overboard, two vessels losing two men each and six vessels one man each. It is doubtful whether any previous record will show as many lost during a single storm by being washed overboard. Much suffering was experienced from the excessive cold weather.

Among the arrivals, schooner Fitz J. Babson reports that on February 27, on George's Bank, the decks were swept and three dories stove by a heavy sea, and that as soon as the deck was cleared a small-sized live mackerel was found to have been washed aboard. This may be recorded as the first mackerel caught this season. During the month the fishermen have several times reported finding mackerel in the stomachs of codfish caught on George's Bank.

The frozen-herring fleet from the United States to Fortune Bay, Newfoundland, numbered twenty sail, all belonging to Gloucester. One has previously been reported wrecked† while on the way home; the others all brought full fares, the last to arrive being the schooner Herman Babson, arriving March 8.

Codfish have been abundant, and when the weather permitted fishing a good catch has been made on George's Bank and in Ipswich Bay. The fleet in Ipswich Bay numbered forty-three sail that used trawls and seventeen sail that fished with gill-nets. Before the gale, which destroyed many nets, those using them were doing well. The schooner Sarah

* On the Development of Viviparous Osseous Fishes. Proc. U. S. Nat. Mus., 1885; pp. 128–155, pls. VI–XI.

†See F. C. Bulletin, 1886, p. 79.

C. Wharff took 36,000 pounds of codfish with gill-nets, while fishing only three days in Ipswich Bay; and sold the same at $4 per 100 pounds, netting over $1,400. The price just mentioned was exceptionally high; while during the month prices for all kinds of fish have ruled lower than for years, the exceptional cases being on fresh fish, with which the market would be poorly supplied during stormy weather.

The codfish found in Ipswich Bay seem to have followed in, or been followed by, a large body of shrimp, their stomachs being full of them. The shrimp are from two to four inches long, of a bright red color, and full of spawn. The codfish taken in Ipswich Bay average seventeen pounds each, about half of them being female fish.

The mackerel vessels have been getting ready for their season's work, which is close at hand. The catch of mackerel before June is generally regarded as unprofitable and injurious to the business. It has been expected and largely desired by producers and dealers that Congress would pass a "close season" law, prohibiting the catch or importation of mackerel until June. The mackerel vessels began to leave for the southern fishing grounds on March 11. No mackerel had been seen up to the close of the month. Not so many sail as usual will be engaged in this branch of the fisheries early in the season, yet by the middle of April one hundred sail will be on the fishing grounds. As long as *any* go early, many who are opposed to fishing for mackerel so soon in the season will go with them.

Although much of the time during the month the weather was stormy and vessels were obliged to remain idle, fish have been abundant and good average fares brought in. The receipts at Gloucester of cod and halibut, the two leading varieties, as compared with the corresponding month last year, show an increase, as follows:

Month.	Number of fares.	Cod.	Halibut.
		Pounds.	*Pounds.*
March, 1885	179	4,266,000	693,500
March, 1886	190	4,568,334	1,106,100
Increase, 1886	11	302,334	412,600

Receipts of fish at Gloucester, Mass., in March, 1886.

From—	Fares.	Codfish.	Halibut.	Haddock.	Frozen herring.
		Pounds.	*Pounds.*	*Pounds.*	*Number.*
George's Bank	122	4,114,334	165,600	623,000	
Brown's Bank	7	180,000	37,000		
Banquereau	2		55,000		
La Have Bank	1	15,000	10,000		
Western Bank	1	10,000	6,000	40,000	
Ipswich Bay, trawls	12	113,000			
Ipswich Bay, nets	14	136,000			
Newfoundland	1		40,000		
Fortune Bay, Newfoundland	3				1,250,000
Bay of Fundy	3				610,000
Grand Banks	24		792,500		
Total	190	4,568,334	1,106,100	663,000	1,860,000

Additional, 10,000 boxes of smoked herring from Grand Manan.

33.—SHAD IN THE SAINT JOHN'S RIVER, FLORIDA.

By W. DEMPSEY.

I began fishing in the Saint John's River in 1865. Then there were from 7 to 10 nets fished along the river, with from 1,500 to 2,500 fathoms of twine. Now, from Jacksonville to Saint John's, there are 100 nets, with about 250,000 fathoms of twine. One hundred boats are also used, employing 200 men, while probably 20 more are engaged in handling the fish.

The figures here given will serve to give some idea of the catch, which was a good one this winter, at the town of New Berlin; but beside the shad I handled, there were small amounts caught by 6 other nets fished from this place, and a few nets were fished by small boys. The following table shows the number of nets used (whose catch I handled) per day, the daily catch of shad, and the average number of shad taken per net during each of the four months of the season, which here begins on December 1 and ends on March 31:

Shad taken at New Berlin during the season of 1885–'86.

Day of month.	December.		January.		February.		March.	
	Nets.	Shad.	Nets.	Shad.	Nets.	Shad.	Nets.	Shad.
1	6	36	12	220	14	182	14	465
2	7	191½	7	22	23	1,520	10	333
3	11	264½	....	....	21	934	18	658
4	12	202	18	490	23	1,839	22	1,301
5	15	560	14	186	18	1,785	14	799
6	....	....	13	204	19	305	11	344
7	16	354	8	24	....	....	....	....
8	15	207	11	183	2	5	19	508
9	16	906	14	717	21	2,010	9	60
10	13	345	....	....	24	2,592	20	1,635
11	13	748½	3	57	22	1,213	21	758
12	16	876	4	49	15	283	10	326
13	....	....	8	107	23	1,004	13	529
14	11	215	7	43	....	....	....	....
15	11	257½	6	30	7	63	18	680
16	12	278	1	4	21	3,071	13	359
17	8	104	....	....	25	1,664	19	666
18	17	228	6	26	20	498	19	1,142
19	9	90	4	12	8	122	20	738
20	....	....	8	58	16	640	20	1,132
21	16	201	16	264	....	....	....	....
22	13	177	5	79	3	13	19	667
23	15	232	13	88	1	11	14	407
24	8	116	....	....	14	130	8	166
25	9	256	19	1,137	22	2,945	11	244
26	19	455	21	471	21	1,222	16	429
27	....	....	19	227	21	1,934	12	486
28	2	7	10	151	....	....	....	....
29	2	2	21	391			13	331
30	3	23	12	372			14	808
31	9	36	....	....			13	442
Total	304	7,366	280	5,612	404	25,985	410	16,413
Average per net	....	24	....	20	....	64	....	40

NEW BERLIN, FLA., *April* 13, 1886.

Vol. VI, No. 7. Washington, D. C. June 12, 1886.

34.—THE PRESERVATION OF NETS.*

If nets and other fishing apparatus go to ruin in a short time, when not exposed to powerful external influences, the reason for this must be sought partly in the quantity of animal matter which adheres to the apparatus and which decays under certain conditions of temperature, and partly in the myriads of infusoria which penetrate among the fibers and there deposit their eggs. From these eggs, during summer, a new generation of infusoria is developed, which again in their turn lay eggs, and so forth. Not only is the fiber weakened by its component parts entering new chemical combinations, but portions of it certainly also serve as food for the infusoria. The looser the thread, the easier will they find their way into it, and the sooner will it be destroyed. With the view to preserve their nets, the fishermen use every opportunity to dry them; and for this purpose a place should be selected which is shady, and where there is a strong current of air.

Everybody knows that fishing apparatus should never be stored away when wet. If necessity compels one to do this, salt is sprinkled between every layer, or sea-water is poured over them. Nets (especially herring-nets and nets used during summer) should be cleaned often, or soaked in birch lye, or, as is done in Nova Scotia, in a decoction of pine or spruce bark. During the fishing season the nets in Nova Scotia are cleaned every week, being laid in the decoction Saturday night, and remaining in it till Monday morning. Apparatus can thus be preserved by killing the animalcules which attack the material of which the nets are made; but they may also be prepared in such a manner as to resist these attacks to a certain degree.

The simplest method of preserving nets consists in smoking them; thereby they become penetrated with creosote, whose antiseptic qualities are well known. If the smoking is repeated from time to time, this method of preserving nets, in spite of its simplicity, is not to be despised.†

Hot coal-tar will certainly prevent the nets from decaying during use, but it makes them hard and stiff, and the twine becomes brittle at the knots and is apt to break.

Hot wood-tar or coal-tar thinned with oil of turpentine also makes the nets stiff and brittle. The same is the case with boiled linseed-oil.‡

Charcoal-tar is apt to "burn" the nets.

---

* "*Bevaring af Garn.*" From the *Norsk Fiskeritidende,* Vol. V, No. 2, Bergen, April, 1886. Translated from the Danish by HERMAN JACOBSON.

† Mittheilungen des Deutschen Fischerei-Vereins. Berlin, 1885.

‡ Fishing Gazette, March, 1884.

The Scotch formerly used tar and oil of turpentine. The tar was first boiled for one hour, whereby it lost some of its "burning" quality, when an equal quantity of oil of turpentine was added, heated to a temperature of 104°–122° Fahr. The nets were then drawn through the mixture. Instead of tar, thick turpentine was also used, and the superfluous moisture was pressed out by letting the nets pass through a machine with two cylinders. When treated in this manner they kept their natural color.

In Newfoundland pine, spruce, or birch bark is boiled until the liquor has the required strength. It is then drawn off and tar is added in the proportion of one part tar to twenty parts of the mixture.

In France the fishermen use a solution (2 to 4 per cent strong) of alum and water, or sulphureted copper or oxide of zinc. From England we have received the suggestion to use alum dissolved in water and buttermilk (2 ounces or 62 grains per gallon), in which the nets are laid for six hours.

In Europe nets at present are generally tanned. Especially has catechu * (*Terra japonica*) found great favor during the last 30 years for tanning nets.

There are 3 kinds of catechu: †

(1) *Gambier catechu.*—This is obtained by boiling the branches and leaves of the gambier plant which grows in Farther India and on the islands of the Indian Ocean. When it has evaporated it forms a clay-colored mass, which is cut in inch cubes. When these cubes are dry they are dark brown on the outside and light brown inside. Occasionally much smaller cubes find their way into the market; but these are frequently adulterated with dried blood, flour, &c.

(2) *Palm catechu.*—This is obtained by boiling the fresh nuts of the betel palm. There are two kinds, namely, the *Kassu*, which is formed into round bricks, dark brown, 2 inches broad and one-half inch thick, often covered on one side with rice-husks; and the *Coury*, which has a yellowish brown color, and which when broken shows an earthy surface, easily distinguishable from the *Kassu*, which shines on the broken surface. Both these kinds are of an inferior quality.

(3) *Cutsch.*—This is obtained from a species of acacia growing in India, but now cultivated also in the West Indies. Pegu catechu comes in dark brown lumps packed in leaves. It is heavier than water, has a bitter taste, and is said to contain 55 to 58 per cent of tannin. Bengal catechu has a grayish brown color, and when broken shows shining streaks or layers. It generally comes in lumps of 1 to 3 inches in diameter. It contains about 50 per cent of tannin.

Purified catechu comes in cakes weighing about one pound each. It is generally adulterated.

The characteristics of good catechu are that it has a brown color, and

* It became known in Europe in the sixteenth century and was used in medicine.

† Danish Fiskeritidende, 1885.

when broken shows a fatty, shining surface. When in greater masses catechu should be close and of uniform quality, and have as few holes as possible. Good catechu dissolves slowly in hot water.

The Association for the Promotion of the Danish Fisheries has chemically examined 9 samples of catechu, which contained from 12.15 to 18.25 per cent of water, from 77.05 to 83.94 per cent of organic matter, and from 1.10 to 7.40 per cent of inorganic matter. In five of the samples the quantity of tannin varied from 48 to 61 per cent. The retail price varied from 6⅓ to 9½ cents per pound.

Catechu is often adulterated by mixing it with potato starch, red clay, sand, alum, &c.* When mixed with inferior catechu or other substances, this may be recognized by the color, which is dark brown, almost black; and by the taste, as it does not have the pleasant sweet after-taste which is peculiar to good catechu. The adulteration can also be ascertained chemically. A solution of good catechu in water assumes, when iron vitriol is added, a green color, while when mixed with other substances it turns violet or black. When earth, sand,† or similar substances are added to give it a heavier weight, these substances will sink to the bottom when the catechu is dissolved in water, vinegar, wine, or spirits of wine. When the catechu is burned these substances remain. The presence of starch can be proved by a tincture of iodine, which gives the sediment a blue color. After the catechu has been dissolved, first in cold water and then in spirits of wine, the starch sinks to the bottom.

For tanning with catechu Mr. A. E. Maas, the Norwegian consul at Scheveningen, has given the following directions: One kilogram [2⅕ pounds] of the best catechu is dissolved in 40 liters [42¼ quarts] of water, and this proportion is observed whatever the quantity of catechu which is boiled.‡ There must be enough of the solution to cover the nets entirely in the vessel in which they are tanned. Care should be taken that the nets lie as loose and easy one upon the other as possible. The solution is not poured upon the nets until the catechu is entirely dissolved; and it should be poured over them as hot as possible (about 140° to 158° Fahr.), but not boiling. The nets should lie in the solution for 24 hours, when they should be taken out and spread to dry. Great care should be observed not to take in the nets until they are entirely dry. The solution which remains in the tanning vat is carefully put back into the cooking vat and mixed with water, until there is enough liquor to dissolve the same quantity of catechu as during the first tanning, namely, 1 kilogram to 40 liters; and thereby a solution is obtained

*Dr. Herman Klenke: "*Lexikon der Verfälschungen*" [Dictionary of adulterations], Leipsic, 1879.

†Sand is said to make the catechu keep better; and it has sometimes been found to contain as much as 26 per cent of sand.

‡Mr. E. de Brauwer, the Belgian commissioner at the Amsterdam Exposition of 1861, says in his report that the liquor must not be boiled but heated to 176° Fahr., because boiling changes the nature of the liquor and makes it corrosive. Rev. Mr. Löberg, in his book *Norges Fiskerier* [the Fisheries of Norway], says the same.

for the second tanning. In the same manner a solution may be prepared for each subsequent tanning.

Cotton nets, which are to be laid in oil, should first have been tanned three times in the manner described above, whereupon they must be well dried before they are laid in unmixed linseed-oil which has not been boiled. The oil should not be heated at all, but should rather be as cold as possible. The oil is poured into a vat in the proportion of 1 pound of oil to 1 pound of nets, therefore as many pounds of oil should be used as are equal to the weight of all the nets which are to be laid in it. After the nets have been laid in the oil they are taken up again and passed between two rollers, so that as much oil as possible may flow off and remain in the vat. The nets are then laid in a vat with a double bottom, so as to catch the oil which may still run off them, and to prevent the lowest layer of nets from remaining in the oil. The nets are left in the vats until no oil drips off them, which generally requires 12 hours. The nets are then spread out to dry on flat ground in the open air, and remain there until they are thoroughly dry. If oil is still dripping from them they may be turned from time to time, but they should never be hung up to dry, and should never be packed one upon the other; even if it rains and storms they should be left undisturbed, for if they are packed together too soon they may take fire. Much rain will hurt nets soaked in oil, but there is no remedy for it.

When the nets are thoroughly dry they are again soaked in catechu once or twice more and dried in the manner described above. When this has been done they may be kept in a cool place.

The rule therefore is: Tan the nets three times in catechu, then soak them in oil, and then tan them once or twice more. After every trip the nets are tanned again, but are not soaked in oil; but some linseed-oil is added to the catechu solution. Cotton nets which are to be tanned only in catechu, but are not to be soaked in oil, should be tanned five times in catechu. Hemp nets need be tanned only three times.

Mr. William Hearder* recommends the following method:

Take 1 pound of catechu to $2\frac{3}{8}$ gallons of water, and dissolve the catechu in the water by boiling.

The nets are to be laid in the solution over night, care being taken that the fire is out before the nets are put into the kettle. As a general rule, $\frac{1}{2}$ ounce of sulphureted oxide of copper is added to 1 gallon of water, and occasionally some glue, which the author, however, does not recommend, as it is soon washed out, and takes out some of the tanning. When the nets have been taken out of the kettle they are washed in pure water and dried.

Mr. Arthur Evans gives the following method in a pamphlet which gained a prize in 1874, and was published by the Baroness Burdett-Coutts:

The essential condition of success is that the nets should be well tanned from the beginning; for, if this is not done, they are soon ruined,

*Fishing Gazette, March, 1884.

and the damage cannot be repaired later. It is therefore necessary first to remove all fatty and oily substances which may have been used in the manufacture of the nets, as they prevent the liquor from penetrating the nets.* This is done by putting the nets, without pressing them too much, into a kettle with boiling water and letting them cook for about an hour, stirring them from time to time to prevent them from sticking to the bottom. When taken out they are laid on a slanting board and pressed, so as to get the water out of them as much as possible. They are finally spread out to dry, and when thoroughly dry they are ready for tanning. The tanning is repeated four times before the net is considered ready for use.

First tanning.—A kettle is filled with as much water as is necessary to keep the nets under water, when they are laid in it, without being pressed too hard. One need not fear that the first solution is too weak, for it is better that it should be too weak than too strong, as in the latter case it will not sufficiently penetrate the twine, but form a sort of crust over it, which will crumble off when the net is used. For the entire tanning process 1 pound of the best kind of catechu is used to every pound of nets. For the first tanning one-half is taken and dissolved in water in a kettle. When the catechu is completely dissolved no more fire is kept under the kettle than is necessary to keep the liquor simmering. The nets are then laid in the kettle and boiled for two hours, stirring them well. When they have boiled the required time they are taken out, laid in tight vats and pressed, and the solution is poured over them, and the vats are covered up. They remain in the vats for forty-eight hours, when they are taken out, wrung, and laid out to dry. When they are thoroughly dry they are ready for the second tanning. Care should, of course, be taken not to spill any of the solution, as this is to be used for future tannings.

Second tanning.—The solution from the first tanning is put into the kettle, and water is added if there is not enough to cover the nets. Half of the remaining catechu is put into the kettle, and when it is completely dissolved, the solution, when boiling hot, is poured over the nets, which have meanwhile been piled up in a water-tight vat. The remaining process is the same as in the first tanning.

Third tanning.—The same process is followed as in the second, the remainder of the catechu being used, and if necessary some water is added.

When the nets are dry, after the third tanning, they are well washed in sea-water, to which is added about a gallon of lime-water, prepared the day beforehand, so that the lime has time to sink to the bottom. The object of the washing is to remove all catechu particles which may have adhered to the twine, as they may cause the fourth tanning to be a failure, and the object of the lime-water is to fix the color. The nets are then again well dried and are hung up.

* In Norway the fishermen sometimes boil the twine before it is used; but it is under all circumstances better to boil the nets.

Fourth tanning.—The remaining catechu solution is poured into the kettle, and if the quantity is not sufficient, some water is added. As a general rule 9 quarts are used for a net 100 yards long and 300 meshes deep. To the solution are added 2½ quarts of Stockholm tar, and as much coal-tar for every net of the above dimensions. When the solution begins to boil, the fire is kept low, so as to keep it simmering during the operation. It should be constantly stirred, as otherwise the first nets will absorb all the tar.

The tanning is done in this way, so that the net is drawn through the solution either by hand or by means of a winch, one man drawing the net, one stirring the solution, and the third helping the net along. To scrape off the superfluous solution, a piece of wood 4 or 5 inches broad, is laid across the kettle and fastened to it. In the middle of the piece of wood is a semicircular notch, about 1 inch deep and 1½ inch broad. Over this notch there are placed 2 iron cramps about 5 inches long; the one having a width of 2 inches is placed inside (towards the middle of the kettle), the other, having a width of 1½ inch, on the outside (towards the edge or towards the person who draws the net). The net thus passes over the piece of wood between the notch below and the cramps above. The size of the opening or the pressure can be regulated by driving the cramps in further. During the night the nets are laid to dry, and are then ready for use.

As regards the treatment of the nets during the fisheries, the same author says that they should be covered up when not in use, and be dried at least once a week. Before they are dried they should be washed so as to be free from all impurities; and while being dried they should be spread out well, so that the drying process may be accomplished rapidly. As soon as they are dry they must be taken in, as bleaching will hurt them. If a rich haul has been made, they should be washed, even if there is no occasion to dry them later. If one thinks that there will be no occasion to use them for twenty-four hours or more, they should be freely sprinkled with coarse salt. If they are left idle for some time, they should be aired both in the morning and evening, and be sprinkled with salt. This is especially necessary in summer, when the air is warm, the sea is full of organic substances, and the fish are fatter. When the nets are in daily use, they should be tanned over again every month in summer, and every six weeks in winter. During the first year they are in use, 14 pounds of the best catechu is used for 3 nets 100 yards long and 400 meshes deep; when the nets have been in use longer, the same quantity will suffice for 4 nets. The catechu is placed in a wicker basket, so that any leaves and impurities which may adhere do not find their way into the solution; and this basket is hung in the water in the kettle, a few inches from the bottom. Only pure water should be used, and never any solution which has been used before. When the catechu has dissolved, the boiling solution is poured into a vat, and the nets are dipped into it. For this sticks are used,

as also for taking the nets out, the main point being that the solution should get on the nets as hot as possible, and it would take too long to wait till it has cooled off sufficiently to use the hands. When the process is finished, the nets are laid in a pile and covered up. Thus they should be left to lie for a few hours. If the work is finished in the evening they may remain lying over night.

When nets are to be stored away all the lines should be kept separate from the nets. Before being laid away the nets should be soaked in fresh water for twenty-four hours, so that all the salt may come out, for salt will attract moisture. While drying they should be taken in every evening and during rainy weather. The best place to keep them is an airy loft, where they are either hung up or piled up loosely. In the latter case they should be aired every now and then, especially in damp weather.

In conclusion we will mention the following methods of preserving nets or of employing catechu:

To 1 quart of water take ½ pound of catechu; in this solution, when cooled off, the nets are laid over night. Before they are dried they are well rinsed in fresh water, which makes them softer than if they had not been rinsed. Occasionally ½ ounce of sulphureted oxide of copper is added to each quart of water. In some places a solution of 4½ pounds of catechu and 3 gallons of oak bark is used for 20 gallons of water.

In Sweden they use, especially for cotton nets, a decoction of birch bark, cut fine. If the bark is fresh it can be boiled immediately, while old and dry bark is first soaked for three days. To 26 gallons of water take 4 gallons of bark and about 13 pounds of soda, and boil the whole for three or four hours. When the solution has cooled off it is poured over the nets, which are laid in vats or barrels. When they have been thoroughly penetrated by the solution they are dried. If the nets are in use they should be tanned every month. For new nets, the first time, 2⅗ pounds of catechu are used to 26 gallons of water.

In many places bark is used instead of catechu, and in Norway bark is used almost exclusively. All kinds of bark are used; the tannin and the coloring matter may be extracted from it both by boiling and by cold water. In England oak bark is generally used, and in Norway birch bark. As a rule, the weight of the nets and of the bark used should be the same, and 30 gallons water should be used to 40 pounds of bark. If the bark is boiled, a little less may be used. Tanning in a boiling solution will make the nets more durable, and will take less time, as the nets need not be left in the solution more than 24 hours. In this case they should be well covered. Owing to lack of suitable vats for large nets, cold tanning is generally employed, and the process is carried on either in the tanning vat itself or in a special vat, sometimes even in a boat. The soaking of the bark, so as to give the solution the necessary strength, takes 4 or 5 days in summer, and about 14 days in winter. When the solution is ready, tanning begins, the nets

being laid in the solution for 3 days, when they are taken out and dried. Generally the tanning is repeated twice; and there are therefore in all 3 tannings. The old bark in the vat is stirred each time and new bark is added until the solution regains its original strength. Occasionally fine lime (1 part to 100 parts water) is used for fixing the solution. In this solution, which should be prepared the day beforehand, the nets should be dipped. The color will show as soon as the net is put into salt water. After every fishing the tanning should be repeated once; and care should be taken, first to clean the net, and especially to remove all fatty substances. As regards the treatment of the nets during the fisheries, the same rules apply as are given above.

METHODS USED IN FAGERHEIM'S NET FACTORY, BERGEN, NORWAY.

Tanning nets.—For every 132 pounds of nets 14⅓ pounds of catechu are dissolved in 38 quarts of boiling water. The solution is poured over the nets, and they remain in it until it has grown cold. The tanning is repeated three times, the nets being dried after each tanning, and a fresh solution is used every time. An experiment has been made in using fine lime with birch bark. It gives the net a purplish color.

Galvanizing nets.—A solution of ⅝ pound of copper vitriol and 120 quarts of cold water is used, in which the nets are laid for 24 hours. To make the solution requires 24 hours. For 36 pounds of nets 1 pound of the vitriol is used.

35.—SALMON FISHERIES OF HALLAND, SWEDEN, ESPECIALLY IN THE RIVER VISKAN.*

By FILIP TRYBOM.

From various sources I have obtained data relative to the salmon fisheries in the river Viskan during thirty-seven years ending with 1884. From these data it appears that the smallest average weight of the salmon per month was found most frequently (in eighteen years) in August, and in eight years each in September and July, twice in October, and once in April. It should be noted that in more than one-half of the years when the smallest monthly average weight was found in August, the fisheries came to an end in that month. This applies not only to the Viskan, but to all the rivers of Halland. The salmon had the largest average weight in July in eighteen years, in May in nine years, in April in five, in March in three, and in February and August in one year each. In the rivers Nissan and Lagan the average weight in 1884 was largest in June; while in the river Rhine the largest salmon are caught during the period from December to April.

* "*Laxfisket i åarne, särskilt det i Viskan.*" From "*Om Fiskerierna i Halland* 1884," Lund, Sweden, 1885. Translated from the Swedish by HERMAN JACOBSON.

The largest number of salmon, and frequently also the heaviest weight was obtained in August and July, but the number of salmon was in many years nearly as large in May and April. This is of great economical importance, for it is well known that salmon fetches a much higher price in spring and early summer than later in the season, when the fish are smaller and leaner; the earlier the great hauls are made, the better it will be. During the last years of the above period, especially from 1879, these large hauls have as a rule been made in August and July. The smallest hauls, both as regards number and weight, have generally been made in March and September; but from the year 1853 this circumstance is of no importance, as from some cause or other the fisheries from that year on did not come to a close in August; fish were still caught during the early part of September. The number of fish caught has been smallest in six, or (if September after the year 1852 is not taken into account) in eight, years during the month of June, and in four years during July. The smallest weight, however, in June was only in three years.

It would be exceedingly interesting if we had the condition of the water, wind, and temperature during all of the thirty-seven years considered; it is well known that the changes in the quantity of water in small streams exercise a considerable influence on the salmon fisheries. When there are strong spring floods the spring fisheries are generally good. If there are no strong floods till later in summer, the largest fisheries take place at the same time as these floods. As with few exceptions the strongest floods and the highest water come in autumn, and as the weirs in the river Viskan cannot be passed by the salmon till that time, it is very important that nothing should hinder their ascent in autumn.

The minimum annual number of fish caught during the above period was 207, weighing 3,241 pounds, and the maximum annual number was 768, weighing 9,348 pounds. During the thirteen years 1843–1856 the average number of salmon caught per annum was 529, weighing 5,902 pounds; during the thirteen years 1856–1869 the average per annum was 410 salmon, weighing 3,929 pounds; and during the period 1874–1884 the average number of salmon was 389, and the average weight 3,976 pounds. In August, 1874, the water of the Viskan was polluted by refuse from a factory at Rydal, and the circumstance that in spite of this the salmon fisheries did not decline to any considerable extent after that year, must be ascribed to the hatching of salmon, which after 1874 was carried on for a number of years. The facts that very few salmon were caught in 1878, and that the average weight of the salmon was greater that year than in any of the thirty-seven years in question, and that in 1878 but few small salmon were caught, while they again occurred in large numbers after 1878, are owing to another pollution of the water which took place in that year.

36.—NEW ENGLAND FISHERIES IN APRIL, 1886.

By W. A. WILCOX.

The customary activity and enthusiasm in the fishing industry at this season has not been observable during the past month. The fear of a treaty with England, or some arrangement by which foreign-caught fish would be admitted free of duty, has been a cloud over the business all the spring. This has in a measure disappeared, only to be followed by others—by disasters, an unusually small demand, and the lowest prices for years—all of which had a depressing effect, and vessels have been fitted out for the fishing grounds but slowly.

Contrary to the expectations of many, since July, 1885, at which time the small duty was imposed upon pickled and dry fish of foreign importation, prices have been much lower and the demand less than in past years, when imported fish was free of duty. This may largely be accounted for by the great decline in all other provisions, fish apparently suffering the most.

The aggregate receipts for the month vary but little from those of the corresponding month of last year; more vessels have been engaged in the halibut fishery and less in the cod fishery. The receipts of the former accordingly show an increase; the latter, a decrease.

George's Bank has been the fishing ground for a large fleet of nearly 200 sail, three-fourths of which were from Gloucester. Cod and haddock were abundant, but vessels averaged small fares of codfish from having poor bait. The haddock catch being marketed at Boston fresh, the receipts at Gloucester show only the small amount of haddock that arrived from an occasional overstocked fresh market. Halibut have at times been plentiful, and again few were taken on these grounds.

Ipswich Bay, from October until May, is a favorite resort for codfish, and is one of the most prolific fishing grounds on the coast. During the past six months the fish have been abundant most of the time, more so than for years. The fleet fishing in this bay during January, February, and March numbered 42 sail of netters and 20 of trawlers; during April 40 vessels used trawls and 20 used nets. As this change was caused chiefly by the nets having been worn out so near the end of the season, they were not replaced.

In the absence of full returns we notice a few of the Ipswich Bay fleet: Schooner Northern Eagle, from October 17 to April 28, with 12 men and 30 nets, caught 327,000 pounds of cod and 80,000 pounds of pollock; schooner Sarah C. Wharff, December 15 to April 25, with 8 to 10 men, 4 or 5 dories, and 40 to 48 nets, caught 567,000 pounds of cod; schooner Hector, October 10 to April 30, with 10 men and 24 nets, caught 227,000 pounds of cod and 144,000 pounds of pollock; schooner Abby A. Snow, October 16 to April 30, with 12 men and 30 nets, caught 330,000 pounds of cod and 97,000 pounds of pollock; schooner Estelle S. Nunam, with

10 men, caught with trawls 60,000 pounds of cod in three days; schooner Clara R. Grimes, with 12 men, caught with trawls 50,000 pounds of cod in 3 days. The pollock were caught in Massachusetts Bay; codfish were all caught from 1 to 5 miles from shore in Ipswich Bay.

Halibut receipts show an increase of 324,890 pounds over the corresponding month last year. All arrived fresh, and were caught mostly on Grand and Western Banks; one fare of 30,000 pounds caught off Newfoundland arrived in a British vessel. Prices have widely fluctuated, generally low, on April 22 selling for 2½ cents per pound, the lowest price for many months.

Mackerel have been a few days late in showing up and working north. The fleet daily left for the fishing grounds, 125 sail being engaged about the last of the month. The first catch of mackerel for the past eight years has been as follows:

Year.	Date.	Year.	Date.
1879	April 13	1883	March 31
1880	April 2	1884	March 31
1881	March 22	1885	March 28
1882	March 31	1886	April 10

Forty sail of the fleet were this year, on April 10, in latitude 37° 55′, longitude 75° 10′, when the first mackerel were seen. The schooners Alice C. Jordan and Ellen M. Adams, both of Gloucester, were the only vessels that secured fares. The first new salt mackerel arrived at New York on April 26, and sold for $5 a barrel. Quite a large body of mackerel was seen the first of the month, but foggy weather much of the time prevented fishing, and only a small amount has been landed. The catch has nearly all been marketed fresh, selling at low prices, ranging from $1 to $6 per 100 fish, mostly at $1 to $2 per 100.

Another year may now be added to many previous ones as financially disastrous to all engaged in the early southern mackerel fishery, and by many it is thought to be injurious in other ways.

Iceland and Greenland will be visited on halibut trips by nine vessels, all from Gloucester, and the only vessels that will fish in these waters from the United States this year. The names and dates of sailing of this small fleet are as follows:

Name of vessel.	Date of departure.	Destination.
Schooner Mist	April 1	Iceland.
Schooner Margaret Mather	April 8	Iceland.
Schooner Landseer	April 9	Iceland.
Schooner Mystery	April 15	Iceland.
Schooner Clytie	April 15	Iceland.
Schooner Arthur D. Story	April 19	Iceland.
Schooner Mary E.	April 9	Greenland.
Schooner Herbert M. Rogers, ready to sail April 30 for Greenland.		
Schooner Seth Stockbridge will sail June 2 for Greenland.		

Weir and trap fishing will be carried on much more extensively than of late years, a large and constant demand for fresh bait being made by the New England fishing fleet. Up to the last of the month but few fish had been caught, the weirs having been down but a short time, but herring seem to be late in arriving. On April 13 the first herring, only 27 fish, were caught in traps in Gloucester harbor.

In addition to numerous minor disasters, the following fishing vessels have been lost during the past month: Schooner Electric Light, bound south on a mackerel trip, on the evening of March 27, when 25 miles south of Cape Henry, during a dense fog, was run into by the schooner Anne Lord, of Bangor, Me., and immediately sunk. The crew were saved, all else being a total loss. She was a fine vessel of 93 tons, built in 1883; the loss of vessel and outfit was about $11,000. On April 23, schooner Eureka, on a mackerel trip, sunk at Delaware Breakwater; crew saved; loss $4,000. Schooner Nettie Adams, shore codfishing, during a dense fog went ashore at Rye Beach, N. H.; crew saved. The vessel was small, old, and not of great value.

Receipts of fish at Gloucester, Mass., in April, 1886.

From—	Fares.	Codfish.	Halibut.	Haddock.	Hake.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
George's Bank	137	2,962,000	145,400	155,000	5,000
Grand Banks	31		954,000		
Brown's Bank	11	256,000	62,200		
Western Bank	11	755,000	72,000		
New England shore	3	30,900			
Ipswich Bay, nets	6	37,000			
Ipswich Bay, trawls	10	174,000			
Off Newfoundland*	1		30,000		
Banquereau	1		25,000		
Off Sable Island	1		15,000		
Total	212	4,214,900	1,303,600	155,000	5,000
Total, April, 1885	250	4,592,000	978,710	185,000	

* British vessel; duty free.

The following is the position of the New England fishing fleet during the last week of April:

Position.	Object.	No. of sail.
Grand Banks	Halibut	40
Do	Codfish	50
Western Bank	Halibut	20
George's and Brown's Banks	Cod and halibut	180
Off the south coast, latitude 37° to 39°, longitude 74° to 75°	Mackerel	125
On the way to Iceland or Greenland	Halibut	9

The mackerel fleet is working northward in the path of steamers bound to and from the south. The George's and Grand Banks fleets are more or less in the pathway of European steamers. During May over one hundred vessels will be added to the Grand Banks fleet.

GLOUCESTER, MASS., *May* 17, 1886.

37.—PRESERVING FISH IN SCOTLAND BY THE ROOSEN PROCESS.*

By OSCAR MALMROS.

[Dispatch No. 70 to the State Department.]

Referring to my former dispatches inclosing articles by Prof. J. Cossar Ewart, on the preservation of fresh fish,† I now submit the following facts bearing upon the practical working of the "Roosen process" mentioned in Professor Ewart's communication:

1. A number of dried ling, preserved according to the above process, were dispatched from Glasgow, in an ordinary wooden box, without the usual tin lining, in a sailing vessel to Melbourne, Australia, and on arrival there were found to be good. The ordinary mode of transit is in tin-lined and hermetically sealed boxes, which entail in this country an expenditure of £4½ [$21.90] per ton; and it has been found that the fish, after crossing the equator, take on a red fungus which destroys their value. The commercial advantages of the new process are therefore considerable.

2. A box of dried ling similar to the one sent to Australia, and preserved at the same time, was lately opened in Edinburgh in the presence of several officials connected with the fisheries in Scotland or otherwise interested in the experiment. The box was perforated so as to admit air, and although the fish had been caught nine months ago, and had been kept in a damp warehouse, they were generally in a fair condition. Before being packed in the box, the fish were about two days in a solution of boracic acid and salt water, under a pressure of six atmospheres, or 90 pounds, to the square inch.

3. While the foregoing experiments relate to the preservation of dried fish, an experiment with fresh fish seems to have been equally successful. The fish in this instance selected for trial was fresh salmon which had been subjected to the "Roosen process" for three weeks. Its quality was tested by practical men of considerable experience and knowledge of fish, such as the manager of the Highland Fisheries Company, members of the Scottish Fisheries Board, the president of the Edinburgh Fish Trade Association, a member of the Iceland Fishing Company of Glasgow, and others possessing similar qualifications for forming an authoritative opinion on the subject. In the opinion of these men, the uncooked salmon could not be distinguished when placed in the market from fresh fish. Cuts of the same lot of salmon were also tried grilled and hot-boiled, and it was admitted that the fish had lost none of its flavor by the process. An opinion was also expressed by one of these gentlemen that by and by Columbia River salmon preserved in this manner might be sold in Edinburgh at 1 shilling [24 cents] a pound.

---

* Invented by M. August Roosen of Hamburg.

† See F. C. Bulletin, 1886, p. 65.

The cost of the utensils required for the preservation of fish according to the above process amounts in this country to £6½ [$31.63], the cost of a cask being £4, and of a pressure-pump £2½. The cask is very strong, made of steel, and reckoned to last for at least five years. It is capable of containing 300 pounds of fish, requiring 3 pounds of the "Roosen" antiseptic. One pump is of course sufficient for a large number of casks. If the cost of the utensils is distributed over the five years, the annual expenditure for their use will be 26 shillings [$6.32], so that in case the cask is filled only once a year the cost per pound of the fish for the use of the utensils is only a trifle over 2 cents; but as the cask may be filled during a year say twenty times, the cost per pound is reduced to about one-tenth of a cent.

UNITED STATES CONSULATE,

Leith (Edinburgh), Scotland, April 29, 1886.

38.—STATISTICS OF THE FISHERIES OF THE PROVINCE OF BRITISH COLUMBIA FOR 1885.[*]

By GEORGE PITTENDRIGH,

Inspector of the Fisheries.

Statistics of vessels, nets, establishments, and men engaged in the fisheries of British Columbia during 1885.

8 steamers and steam auxiliaries, from 3 to 50 tons 26 schooners, from 5 to 80 tons	$54,600	
867 fishing boats 190 canoes	44,195	
42 flat-boats or scows	5,430	
		$104,225
961 salmon nets, 275,800 yards	114,750	
37 herring seines	4,680	
5 herring nets, 700 yards	2,500	
81 fish seines, 7,061 yards	7,975	
3 eulachon nets	175	
		130,080
25 salmon canneries, estimated value	449,500	
1 oil factory, Queen Charlotte Islands	10,000	
1 oil and scrap factory, Burrard Inlet	45,000	
1 floating cannery and oil factory	60,000	
Various salting stations	11,000	
		575,500
Total value		809,805
Sailors		90
Fishermen and native hunters, with sealing fleet		1,740
Shoremen		960
Total number of men engaged		2,820

* These statistics have been furnished by Captain Pittendrigh, who also states that turbot have been discovered on the Pacific coast, Mr. William Vennan, a reliable fisherman, having taken one outside of Burrard Inlet, near Spanish Bank.

Yield and value of the fisheries of British Columbia during 1885.

Kind.	Quantity.	Value.
Salmon, salted ....barrels..	3,468	$31,212
Salmon, fresh ....number..	204,700	40,940
Salmon, canned, cases 4 dozen 1-pound tins each........cases..	108,517	542,585
Salmon, smoked........pounds..	370,000	37,000
Sturgeon, fresh........do....	354,500	17,725
Whiting, tomcod, &c........do....	241,160	12,058
Halibut........do....	159,000	9,540
Herring and smelts, fresh........do....	36,600	1,830
Herring, smoked........	....	7,000
Fish assorted........pounds..	59,400	3,564
Trout........do....	83,000	5,810
Eulachons, fresh........do....	31,350	1,881
Eulachons, salted........do....	22,500	1,800
Eulachons, smoked........do....	13,000	1,300
Furs, seal-skins........	....	150,019
Eulachon oil........gallons..	450	450
Black shark and dogfish oil, refined........do....	40,000	20,000
Dogfish oil........do....	22,200	5,550
Salmon oil........do....	80	24
Clams and other shell-fish........	....	2,500
Fish sold in markets........	....	120,000
Crabs and prawns........	....	2,000
Salmon and other fish, estimated consumption by Chinese and other laborers on the Canadian Pacific and Island Railway, not specially recorded........	....	62,000
Oysters, native........barrels..	250	1,250
Total........	....	1,078,038
Estimated consumption by Indian population, as revised:		
Salmon $2,732,500		
Halibut........ 190,000		
Sturgeon and other fish........ 260,000		
Fish oils........ 75,000		3,257,500
Grand total of approximate yield........	....	4,335,538

Comparative value of yield in 1884 and 1885, exclusive of Indian consumption:

Total, 1884........	$1,358,267 10
Total, 1885........	1,078,038 00
Decrease in 1885........	280,229 10

39.—SALMON IN THE CLACKAMAS RIVER.

By L. T. BARIN.

[From a letter to J. W. Cook.]

There is no question that the genuine Chinook (or quinnat) salmon (*Oncorhynchus chouicha*) go up the Clackamas River. Some persons, who are opposed to a hatchery being established on this stream, say that such salmon do not go up that river. But the fact is that there is not a single species of the salmon and trout that come up the Columbia from the ocean which does not find its way in large numbers up the Clackamas.

The run of the Chinook salmon commences in March or April, sometimes even in February, and they begin spawning in September.

The silver salmon commence their run with the first rains in the fall, say the middle of September, and begin spawning about the middle of January.

The steel-head salmon, or more properly the large salmon trout, commences its run from the first to the middle of October, and begins spawning about the 1st of May.

The run of the dog salmon commences in November, and they begin to spawn soon after coming.

The salmon above named, including the blueback, are all the species of salmon that come from the ocean up the Columbia and then into the Clackamas. I am thus careful to enumerate all the species to show you that we have them all, and cannot be mistaken. It certainly would be strange if the people who have lived here for years, many of them since 1845 and 1850, should be mistaken as to the species of the salmon, in view of the fact that many of the men who live on the Clackamas go down to the Columbia during the canning season to work at the canneries, and see and handle the salmon caught in the Columbia; and I have heard such men declare that they have caught as fine and as large Chinook salmon in the Clackamas as ever they had seen caught in the Columbia.

Of course the salmon are not so plentiful now as they were, for some years ago the river was literally alive with Chinook salmon; yet, while they are not very abundant now, if a rack should be put across the river early in the season, say in February, there would be no doubt that more than enough salmon could be procured for hatching purposes. Such a rack must be put in early in the season, for I have seen a considerable number of salmon caught in the Clackamas before the fishing commenced on the Columbia.

I have been on all the rivers and tributaries of the Columbia from above the Cascades to Priest's Rapids, to which the Chinook salmon go; in fact, was along these tributaries considerably during three years of Indian campaigning; and I do not hesitate to say that the Clackamas River, with its clear, cold water, its rapids, and its long, shallow gravel-beds, is the most natural and favorite region for salmon spawning.

I am certain that a permanent dam could be built on Clear Creek (a tributary of the Clackamas, about 15 or 20 miles from its mouth), near enough to make it convenient for water for hatching purposes. There are three dams across Clear Creek now; one was put there in 1852, at Harding's Mill, 3 miles above the hatchery; one at Viola, built in 1848 or 1850; and one at Springwater, built in 1865. They have all stood floods, time, and wear, and another could readily be built which would furnish suitable water for a hatching house.

OREGON CITY, OREG., *December* 26, 1885.

Vol. VI, No. 8. Washington, D. C. June 15, 1886.

40.—FREEDOM OF MIGRATION FOR FISH IN GERMANY.*

By H. KELLER.

Thus far the German Fishery Association has mainly devoted its activity to the promotion of artificial fish-culture and to the stocking of our waters with young fry. Millions of young salmon had been placed in those watercourses that seemed to offer a guarantee for their future well-being. These fish have flourished, but unfortunately they do not return. All efforts to regain our former abundance of fish will not reach the object in view until the migratory fish again have free access to their spawning places, and until they everywhere enjoy full protection during the spawning season. If the German Fishery Association has been less active in this direction, the reason for this must be sought principally in the circumstance that the great difficulties can be conquered only by aid of a determined and persistent support from public opinion; and this applies especially to the difficulties which at present are still opposing the unhindered migration of our fine food-fish.

How small do the results of the salmon fisheries of the Rhine—at present counting only by hundreds—appear when compared with the results of these fisheries during the Middle Ages, when it became necessary to protect the apprentices and servants at Cologne and Mayence by an official decree against being compelled to eat Rhine salmon during the season every day, both for dinner and supper! In those times the headwaters of the tributaries of the Rhine, which possess an abundance of excellent spawning places, were not yet cut off by weirs. We have evidence that in former times the tributaries of the upper Moselle, the Lahn, and the Neckar were full of salmon and sea-trout. Now these streams, from which the Rhine received its supply of fry, are inaccessible to the spawning fish. Every new weir constructed in the Vosges Mountains and in the Westerwald has cut off a portion of our salmon, until but faint traces of their former abundance remain. The worst enemies of the migratory fish of the Rhine do not dwell near its mouth but near its headwaters. It is the weirs which make the natural spawning places of the salmon inaccessible, and therefore prevent the increase of this fish. The condition of affairs is still more deplorable in most of the other streams of Germany, many of which have weirs in the middle portions of their course, weirs so high that the salmon can leap over them only under specially favorable circumstances.

* "*Die Freizügigkeit der Edelfische.*" From Circular No. 1, 1886, of the German Fishery Association, Berlin, March 4, 1886. Translated from the German by HERMAN JACOBSON.

Matters are no better in the neighboring countries. We learn the condition of France in this respect from the reports of the "Commission for restocking the French waters," appointed a few years ago by the senate, which, after very careful investigations, has reached the conclusion that, owing to the construction of numerous weirs, the migratory fish have nearly disappeared from the rivers of northern and western France, which, in former times, were full of salmon.

Across the Atlantic we hear the following complaint from the United States: "It is an established fact that our river fisheries have for a number of years decreased steadily, both as regards the quality and the quantity of the fish caught. In some cases certain kinds of fish which formerly were abundant have disappeared entirely. More especially has the number of migratory fish decreased to an alarming degree. The construction of weirs in our rivers has entirely cut off some species of fish from their spawning places, so that their complete disappearance is only a question of time."

The only country where the wealth of fine migratory fish is not on the decrease, but actually increases from year to year, is Great Britain. In England, even among the middle and lower classes, good meat forms a staple article of food, much more so than in Germany. It is well known that, as regards their nutritive qualities, fresh fish do not rank much lower than meat, and are even preferable for people with a weak stomach. From the instructive treatise by the Duke of Edinburgh "On the sea fisheries and the fish of the United Kingdom," we learn that the average annual quantity of fish consumed by every citizen of London is upwards of about 66 pounds, and so about as much as the quantity of beef consumed. The citizen of Berlin has to be satisfied with an annual average quantity of about 9 pounds; while in Vienna, on the banks of the beautiful blue Danube, the average quantity of fish per capita is only about $2\frac{1}{5}$ pounds. Although the fish found in the Billingsgate fish-market in London are principally salt-water fish, the finer river food-fish are also offered for sale in considerable quantities. The price of salmon and sea-trout is low enough to allow these excellent fish to be seen frequently on the tables of the middle classes.

The undeniable fact, that in no country of the world—Canada perhaps excepted—do the fisheries of migratory fish flourish more than in Great Britain, might at first thought be cited as an argument against the hurtful influence of weirs on the fish; for it is well known that Great Britain has made her watercourses from the source to the mouth subservient to industry and navigation by the construction of numerous weirs. If, in spite of this, British salmon fisheries are very productive, the cause must be found principally in the successful efforts of intelligent men to protect the salmon during the spawning season, to introduce rational methods of fishing, and to make the weirs passable. In Great Britain public opinion has declared in favor of an active support of the fisheries much sooner and more generally than on the continent.

Selfish scruples of the owners of weirs, and the anxious doubts of the over-cautious, had to give way before the clearly expressed wish of the majority, which recognized the economical importance of all efforts tending to promote the fisheries.

About forty years ago the rivers of Great Britain, formerly rich in fish, had become depopulated in the same degree as the German streams are now. Especially had the number of migratory fish decreased everywhere to an alarming extent. At that time public attention was directed to the matter of the fisheries, especially to the construction of artificial fishways for passing the weirs, whose height, in connection with the strong current, prevented the fish from passing over them. Numerous coast streams were in the course of years regained for the salmon. The same was done with the larger rivers, such as the Severn, whose tributaries, up to the headwaters in North Wales, have been supplied with fishways. The example of the small Irish river Corrib may serve as an illustration of the results of these efforts. When the fisheries in that river, in the year 1852, passed into the hands of the present owner, they were almost worthless, as the migratory fish could not leap over the weir near Galway. After a fishway had been constructed, and numerous measures had been taken to protect the young fry set out above the weir, the salmon fisheries increased very rapidly. In 1857 about 5,000 salmon were caught; in 1862, upwards of 15,000; and for a number of years the average annual yield of these fisheries has been from 40,000 to 50,000 fish.

These brilliant results have caused people to make even those water-courses accessible for the salmon from which it had hitherto been excluded by natural obstructions. As an example, we may mention the river Ballysadare in Ireland, which up to 1856 had no migratory fish, on account of its falls (from 13 to 20 feet high) and its rapids. But after three fishways had been constructed, and the gravelly beds of the headwaters had been stocked with salmon fry, the number of fish increased very rapidly. Thousands of the finest salmon annually reward the enterprising owner. But this is outdone by an example from Norway. A few years ago the river Sire, having two falls—one 28, the other 88 feet high—was by means of fishways made accessible for salmon. Who can doubt, then, that it is possible to gain the rapid trout-brooks of Switzerland as spawning places for salmon, as the height of the famous falls of the Rhine near Schaffhausen is only about 66 feet?

The few instances where German weirs have been made passable for salmon can easily be counted on the fingers. There are a few successful fishways, and a number which hardly answer the purpose. This is not astonishing when we consider that the subject is somewhat new, and but few of those who constructed fishways in Germany had a chance personally to inspect such constructions in other countries. Actual results cannot be recorded, because these efforts have so far been disconnected and have not embraced entire river territories. At present it

still rests too much with persons who possess the privilege of constructing weirs across rivers, whether a fishway shall be constructed to make their weirs passable for fish. Owners of weirs claim almost incredible indemnities whenever they think that their privileges are going to be infringed in the slightest degree. As a matter of fact, the fishways will in nearly all cases receive an abundant supply of water from the overplus of water from mills, &c. The objections which have been raised against the construction of fishways are, therefore, in most cases based on too great timidity, and on lack of information and experience.

41.—A LARGE CATCH OF CARP.*

By MAX VON DEM BORNE.

During the winter of 1885–'86, by fishing through the ice in the Rosskamp Lake (which belongs to me, having an area of 10½ acres and a depth of 16 feet), I caught 235 carp, weighing 923½ pounds; and in the Bötzen Lake (which I lease, having an area of 151½ acres), I caught 1,536 carp, weighing 5,715 pounds. Among these there were fish weighing more than 10 pounds. My other lakes also have a very good stock of carp, while formerly this fish was not found there at all, and the first stocking of them with carp was in 1871.

As a general rule, during the first years I put in 100, and later 50 one-summer-old carp to one acre of water, usually transferring the fish in autumn, when the carp were about five months old; but sometimes in spring, when the fish were about ten months old. As the lakes contain a great many pike, perch, and bass, many of the young carp were destroyed, but nevertheless a good many grew up to be fine food-fish, as may be seen from the catch stated above. I have also, instead of the one-summer-old carp, set out two-summer-old fish, and obtained the same results from about half the number of carp set out. I prefer, however, to set out younger fish, because it requires at least three times as large a pond area to raise two-summer-old carp.

As a general rule, I consider it a very easy matter to stock a lake with carp. But, on the other hand, it is often very difficult to catch the carp. In summer they are quick and shy, and at that time it is difficult to catch a large fish. But even in winter, during the fishing through the ice, the carp know very well how to avoid the nets, especially when the ice is transparent and the weather clear. In the Bötzen Lake I did not succeed in making any satisfactory hauls until I had enlarged my net so as to catch all the fish in a single haul. And the rich haul of this year I made by setting the net during the night by torchlight, and by having it taken out in the morning.

* "*Ein glänzender Fischzug.*" From Circular No. 1, 1886, of the German Fishery Association, Berlin, March 4, 1886. Translated from the German by HERMAN JACOBSON.

42.—FISHING IN THE NAVIGABLE WATERS OF THE UNITED STATES.*

The Committee on the Judiciary, to whom have been referred House bill 4690 and several petitions in favor of the passage of the same, have fully considered the same, and report as follows:

The proposed bill would give by act of Congress to the citizens of the several States of the Union equal right with the citizens of each State to fish for floating fish in the navigable waters and lakes of the latter. The question involved depends on the title to the waters and lakes referred to.

For purposes of navigation they are free to all the citizens of the several States alike, and the power of Congress to regulate commerce between the States includes the right to prevent any hostile legislation by any State against the equal rights with its own citizens of the citizens of all the other States; or it is forbidden by the clause of the Constitution which gives to the citizens of each State the privileges and immunities of citizens of the several States. (C. U. S., Art. 4, § 2.)

But it is right to inquire whether the citizens of a State acquire their right of fishing in its waters as a privilege derived from the grant of the State, or as vested in them by virtue of ownership as members of the body politic.

It has been settled by the highest authority in the English courts, that ever since Magna Charta, the crown cannot grant to a subject a several fishery in an arm of the sea, or in navigable waters, but that all such waters and the beds thereof are vested in the crown for the benefit of the subjects thereof, and not to be used in any manner to derogate from the right of navigation which belongs to the subjects of the realm. (Free Fishery, &c., *v.* Gann, 115 E. C. L. R., 803 House of Lords Cases, per Lord Chancellor Westbury and Lord Wensleydale (Baron Parke); S. C. in Exch. Chamber, 106 E. C. L. R., 853; S. C., 103 E. C. L. R., 387 Common Pleas.)

This royal title held for the benefit of the subjects of the crown, which cannot be aliened to their detriment, has been thus recognized ever since Magna Charta.

In this country, by a series of decisions, the Supreme Court of the United States has settled the law in accordance with the English courts, that upon the Revolution the rights of the crown in navigable waters and inclusive of arms of the sea devolved upon each State as to all such waters within the territory of each of them. (Martin *v.* Waddell, 16 Peters, 367.)

In Pollard *v.* Hagan (3 Howard, 212) the same doctrine was maintained as to new States, as well as to the original States; and the right of the State fixed to all the beds of rivers below high-water mark.

*Report presented to the House of Representatives by Hon. J. R. Tucker, May 13, 1886.

In Smith *v.* State of Maryland (18 How., 71) the right of the State of Maryland to the shell-fish and floating fish in Chesapeake Bay was established as the sovereign right of the Commonwealth devolved upon her from the crown at the Revolution, a right which she could control without violation of the Constitution by such regulations as were needful to secure this public right without interfering with the navigation of the waters, Mr. Justice Curtis delivering the unanimous opinion of the court. (Accord Mumford *v.* Wardwell, 6 Wall., 436; Weber *v.* Harbor Commissioners, 18 Id., 66.)

In McCready *v.* Virginia (94 U. S. Reports, 391) the unanimous judgment of the court was delivered by Mr. Chief-Justice Waite, by which the right of Virginia to use and appropriate the navigable waters of Virginia for the benefit of her own people for the taking and cultivation of fish as a property right, and not as a privilege or immunity of citizenship, is established, though thereby the citizens of other States are excluded from the same rights. This right is one of property in the citizens of Virginia, and not a privilege or immunity of citizenship.

It is true the last decision, though in the opinion made to apply as well to floating fish as to shell-fish, only applied in fact to shell-fish; but your committee see no reason why the principle of these decisions should not apply to both.

Fish are *feræ naturæ*, and an absolute property in them can only be asserted when restrained of their liberty. This, it may be said, is the case with oysters, which, when planted, have no capacity to move, and distinguishes them from floating fish, which may move out of the reach of the State in whose waters they may temporarily be.

But upon this distinction of nature, no ground can be maintained for changing the decision applicable to the one when the case of the other is adjudicated.

In the case of Riggs *v.* The Earl of Lonsdale (1 Hurlst. & Norman, 923) it was decided in the Exchequer Chamber that the owner of land had a right of property in game killed on his land by a stranger. The fact that the game was *feræ naturæ* did not take from the owner of the land the property therein, even in favor of a stranger who hunted and killed it there.

This case was considered very fully in Blades *v.* Higgs (104 E. C. L. R., 50), where the decision of Justice Willes at *nisi prius*, overruling Riggs *v.* Lonsdale, was reversed by the court of common pleas; and on appeal to the Exchequer Chamber (106 E. C. L. R., 844) the court of common pleas was unanimously sustained; and the judgment of the Exchequer Chamber was affirmed by the House of Lords in S. C., 106 E. C. L. R., 866. The judgment in the House of Lords was sustained by the high authority of Lord Chancellor Westbury, with Lords Cransworth and Chelmsford, both ex-chancellors, concurring. That case decides clearly and distinctly that if A, a hunter, finds, kills, and carries

off in one continuous act, any game, *feræ naturæ*, on the land of B, the dead game is the absolute property of B, *ratione soli*.

That the same doctrine is applicable to fish caught and taken from the waters of the owner cannot be questioned; and the cases referred to by the judges in the discussion of the cases above cited mention fish as of the same character as animals and birds.

Your committee, therefore, being of opinion that the navigable waters within each State belong to it, subject to the paramount right of navigation, for the benefit of its own people, it has the right to secure the exclusive right of fishing in them to its own citizens by virtue of their common property in said waters, and that the citizens of other States have no constitutional right, nor can Congress confer any, to participate in fishing in them.

Your committee recommend that the bill referred do lie on the table, and the prayer of the petitioners be denied. All of which is respectfully submitted.

43.—OBSERVATIONS ON SALMON IN GERMAN RIVERS.*

By Prof. B. BENECKE.

We know but little about the salmon while ascending the different rivers, although this knowledge is of the greatest importance for the salmon fisheries and for the fixing of a rational season of protection. If we except the exceedingly valuable observations on the migration of the Rhine salmon by Miescher-Ruesch, no systematic investigation of this subject has anywhere been made. It is particularly astonishing that even in England, in spite of the great interest which the English take in the salmon fisheries, and in spite of the fact that there is a special inspector of salmon fisheries, and superintendents for every salmon stream, no one seems ever to have thought of subjecting this matter to scientific investigation.

Regular and exact observations have been made recently in the rivers Küddow and Rheda, which are small salmon streams of Germany, in which the circumstances are specially favorable.

The Küddow is a rapid and clear trout stream, which rises from the Vilm and Dolgen lakes near Neustettin, flows from north to south in many meanderings and with a strong current, and finally empties near Uscz into the Netze, a well-known tributary of the Oder. In its middle course the Küddow has numerous spawning places of salmon; and since the reckless fishing which was formerly going on at its mouth, near Uscz, and above, near Schneidemühl, has been checked, salmon ascend the Küddow regularly for the purpose of spawning. Our ob-

* "*Beobachtungen über den Aufstieg des Lachses in den Flüssen.*" From Circular No. 1, 1886, of the German Fishery Association, Berlin, March 4, 1886. Translated from the German by HERMAN JACOBSON.

server is the lessee of the fisheries, who resides in Borkendorf below the lowest spawning places, and who has carried on these fisheries for many years, so that he is well acquainted with the habits of the salmon in this river. It is certain that but few of the ascending salmon escape his observation. At our request the governor of the province has granted him the privilege to catch salmon and sea-trout even during the winter season of protection, on condition that he takes the sexual products from the mature fish and sends them to the hatchery at Schönthal. In this way the Schönthal hatchery during last winter received about 300,000 eggs, of which only about one-third lived.

The conditions for making observations are still more favorable in the river Rheda. This small and rapid coast river, in which trout are now very common, flows through two mouths—the Rheda proper and the Strömming—into an arm of the Baltic, the Bay of Putzig. Formerly salmon and sea-trout ascended both mouths of this river, but since the Rheda proper has been filled with sand, they almost exclusively use the Strömming. In this river a salmon trap, whose privileges date from time immemorial, has been constructed about 1¼ miles above its mouth, and every fish which ascends the river must necessarily be caught in this trap. The fisheries in this river belong to a large landed proprietor whose fisherman lives in close proximity to the salmon trap.

At both stations of observation every fish which is caught is noted, and described on a form prepared by us, and this has been done since November, 1884. We give the date when it was caught, the kind (salmon or sea-trout), sex, length, greatest height in front of the dorsal fin, height of the root of the tail, weight, color, spots (if any), formation of hook, &c.

In course of time it has become evident that the measure of the circumference along the front edge of the dorsal fin is not needed; and it is therefore no longer taken, principally because it is very easy to make a mistake in taking this measure, and because the greatest height alone is sufficient. We have recently added in our form the length of the head, the teeth, and several columns with definite questions relative to the coloring and the spots. It has also been found desirable to take account of the condition of the water and the weather, and to state the probable cause of particularly rich or poor catches, such as high water, ice, &c.

It is of course not to be expected that the chances for observations will everywhere be as favorable as in these two rivers, and that in all cases there will be as reliable observers, but we hope next year to obtain similar reports from a number of rivers. Such observations made by carefully instructed observers are of course far more valuable for obtaining a knowledge of the habits of the salmon than the sending out of question sheets, whose questions are frequently unintelligible to those who receive them, and which therefore in many cases remain un-

answered. Even if these question sheets are returned, the answers are as a general rule of doubtful value.

The observations made last year on the Küddow and Rheda correspond, according to the statements of the fishermen, entirely with the facts observed by them for years, but they differ greatly in the two rivers.

In the Küddow, about 40 to 50 miles from the sea, the first ascending salmon are usually noticed in August; but when the water is low, not until September or October; and only when the water is very high have they been seen as early as June. The fishermen are very well informed on the habits of the salmon during its ascent. In 1884 the period of observation was limited to November and December; last year the fisheries began in August and ended in the second half of November, the largest catches being made during the first half of November. The total number of fish caught during the 4 months was 99, with a total weight of 2,305 pounds; the average weight of the fish was therefore 23.2 pounds. Of this number of fish 36 were males, with a total weight of 1,012.5 pounds, the average weight of each fish, therefore, being 28.1 pounds. The maximum weight of the male fish was 44, and the minimum 16 pounds. Their length varied from 44 to 54 inches. The number of female fish was 63, with a total weight of 1,292.5 pounds. The average weight was 20.5, the maximum 33, and the minimum 11 pounds. Their length varied from 31½ to 47¼ inches. No difference could be noticed in the period of migration of the two sexes. The fish are salmon and sea-trout.

The conditions are entirely different in the Rheda. At the salmon trap before-mentioned the ascent of salmon and sea-trout, which can here be distinguished with certainty is observed all the year round. During winter the trap has to be opened occasionally on account of ice or high water, in order to save it from destruction; but it is probable that even at such times fish ascend the river. Very low water occasionally renders the ascent of the fish difficult or impossible, owing to the great quantity of sand in the mouth of the Strömming. In this river also the governor of the province has permitted the catching of salmon during the winter season of protection, so as not to hinder our observations.

The number of migratory salmon caught during the four months was 245, with a total weight of 1,558.25 pounds, the average weight therefore being 6.3 pounds. Among this number there were 145 salmon with a total weight of 982.5 pounds, the average weight therefore being 6.8 pounds, the maximum 18, and the minimum 1 pound. The total weight of the 100 sea-trout was 575.75 pounds, the average weight 5.75 pounds, the maximum 13, and the minimum 1 pound. As to sex there were 144 males and 101 females. The largest number of fish ascended the river during the first half of July, both when taking all the fish together, and when taking the salmon separate from the sea-trout.

Neither in the Küddow nor in the Rheda could any law be shown governing the migrations of these two kinds of fish; while in the Rhine and in the rivers of Great Britain very easily distinguishable schools of fish of different ages ascend the rivers at different times; and the numerical proportion of the sexes varies greatly in the schools ascending at different times. Observations made during one year in two rivers are of course not sufficient to draw therefrom any general conclusions. The evident differences of the conditions of migration in the different rivers makes it, however, exceedingly desirable that accurate and systematic observations should be taken in as many places as possible, especially in rivers which contain many salmon, such as the Weser, where thus far nothing is done but to count the salmon that are caught, so that all we learn is at best how many fish were caught every day. According to the observations of Miescher-Ruesch, the largest number of salmon ascends the Rhine, both in the Netherlands and near Basel, in July; while in the Weser, according to a communication by Dr. Lindeman in the *Weser Zeitung*, the largest catches were made during the first half of May.

This is not the place to give a detailed review of the carefully ascertained measurements and weights of the fish, especially as the number of fish observed in the two rivers—344—is too small; but I will simply give a few results of my observations on the measurement and weight of the fish. Thus, taking the height of the body as the unit, the length of the salmon varied between 3.6 and 6.2, while that of the sea-trout varied between 3.5 and 5; and these variations occur with tolerable regularity in fish of every size, from 12 to 54 inches. The proportion between the length and the weight of the body, of course, varies just as much. The following are some of the results of my observations:

Weight.	Corresponding length.	Weight.	Corresponding length.
	Inches.		*Inches.*
Weighing 1 pound	12.6 to 15.4	Weighing 16 pounds	42.1 to 45.7
Weighing 2 pounds	12.6 to 18.5	Weighing 17 pounds	42.1 to 47.2
Weighing 3 pounds	18.5 to 22	Weighing 18 pounds	37.4 to 44.9
Weighing 4 pounds	13.4 to 21.7	Weighing 19 pounds	41.7 to 45.7
Weighing 5 pounds	18.9 to 24.8	Weighing 20 pounds	40.9 to 43.3
Weighing 6 pounds	15.7 to 25.6	Weighing 21 pounds	42.5 to 42.9
Weighing 7 pounds	19.7	Weighing 22 pounds	41.7 to 44.9
Weighing 8 pounds	24.8 to 28	Weighing 23 pounds	43.7 to 47.2
Weighing 9 pounds	28	Weighing 24 pounds	45.3 to 46.5
Weighing 10 pounds	28.7 to 29.9	Weighing 25 pounds	44.1 to 45.7
Weighing 11 pounds	31.5	Weighing 26 pounds	45.3 to 47.2
Weighing 13 pounds	28 to 42.1	Weighing 29 pounds	44.1 to 46.9
Weighing 14 pounds	33.1 to 37.8	Weighing 30 pounds	45.7 to 49.2
Weighing 15 pounds	42.1 to 44.5		

A salmon measuring 45.7 inches in length can therefore weigh, in the same water, 16 or even 30 pounds, which ought certainly to involve some difference in the shape of the body.

44.—FISH KILLED BY COLD ALONG THE GULF OF MEXICO AND COAST OF FLORIDA.

By JOSEPH WILLCOX.

[From a letter to Prof. S. F. Baird.]

While in Florida, during and after the severely cold weather last winter, I had ample opportunity to witness the great destruction caused among the fish along the coast from Cedar Keys to Punta Rassa. At Cedar Keys a great loss was reported; but I did not have an opportunity to see many dead specimens there.

In the fresh water of the Homosassa River many thousand catfish were killed by the cold, but they appeared to be the only species that suffered there; while in the salt-water tributaries of the same river many sheepshead and sea-trout (*Cynoscion maculatum*) were killed.

While proceeding farther south, the great mortality among the fish became more noticeable. On the shores of Manatee River the dead fish were seen in great abundance, and from Tampa Bay to Punta Rassa they were washed ashore in the bays, especially in Little Sarasota Bay, in such quantities as to make the air foul from their decomposition.

The greatest loss of life appeared to be among the cavally (*Caranx hippos*). Next were the skipjacks or bonyfish (*Elops saurus*), though many redfish, sea-trout, and sheepshead were also killed. Even the large tarpum (*Megalops thrissoides*) did not escape destruction; many of which were killed in Charlotte Harbor, Manatee County, and in the Caloosahatchee River.

The mortality of the fish enumerated above appeared to be confined to the shallow waters of the bays and rivers, as I saw very few of them on the shore of the Gulf of Mexico, except near the inlets, where the tide-water probably carried them out from the bays. On the shore of the Gulf of Mexico, however, two species of fish killed by the cold weather were seen in great abundance, namely, the cow-fish (*Ostracion quadricornis*) and the balloon-fish (*Diodon maculato-striatus*). A few of the sea-horse (*Hippocampus hudsonius*) were also killed.

Buzzards, eagles, and alligators feasted upon the decomposing fish; but I did not observe any effort made by farmers to use them as a fertilizer for their land, though in many places a cart could have been loaded with them in a short time.

Along the coast of Florida many oysters are exposed above water at low tide, especially when a north wind is blowing. Such oysters were killed in vast numbers by the cold weather in January.

ACADEMY OF NATURAL SCIENCES,
Philadelphia, Pa., May 25, 1886.

45.—ROCKFISH IN SOUTH CAROLINA.

By FRANK BURNS.

[From a letter to Prof. S. F. Baird.]

When I used to fish in the Santee River twenty years ago, old fishermen spoke of rockfish as having been caught there a long time before, but not within the last thirty-five or forty years, except at the junction of the clear water of Eutaw Creek with the muddy water of the Santee. There, it was said, they could be seen at all times of the year in the deep, clear water near the bottom, and were sometimes captured by gigs or spears on long poles. This information agreed with what I had heard of them in the Ohoopee, a small, clear tributary of the Altamaha River in Georgia.

As you are aware, most of our large Southern rivers are now muddy and filthy all the year, and scarcely any fish except catfish and eels can live in them. It was not always so, for they teemed with fish in my early boyhood. There is a class of rivers in the South that rise and run entirely in the cretaceous and tertiary sands, and the water is always comparatively clear, but is sometimes stained a dark color with vegetation. A local name for such streams is Black River, Black Creek, &c.

These streams abound with fish, being famous for shad and all the common fresh-water fish. I will mention a few of them in South Carolina and Georgia: Little Pedee, Waccamaw, Lynch's Creek, Black Creek, Catfish Creek, Black River, the Edisto (with its tributaries, Ashley, Cooper, Combahee, Salkehatchie, &c.) in South Carolina; the Ogeechee, Ohoopee, and Satilla (with its numerous tributaries) in Georgia. These are all clear-water streams, as contradistinguished from the Santee, Pedee, Savannah, and Altamaha Rivers, which are all large, long, muddy rivers rising in the Blue Ridge country and flowing over the clay slates of the metamorphic region.

Now I am informed that the rockfish, or striped bass, is found in all the clear-water streams enumerated, except the Satilla; I never heard of any in that stream, but in some cases they have to go up these large streams in order to get to the smaller clear streams, where they spawn. The spawning season seems to be in April and May, but the fish stay all summer and bite ravenously in October. They are caught in a few favored localities all the summer, sometimes rising to the fly or bob in the tributaries of the Pedee. They weigh sometimes as much as 40 pounds, one having been taken recently weighing 28 pounds.

It seems that the best point to get fish for spawning purposes is at the mouth of the Little Pedee River, where it empties into the Great Pedee above Georgetown, S. C. A Fish Commission steamer could prob-

ably ascend the river to near that point and anchor, while a tug would perhaps be necessary to operate with further. It seems that the Little Pedee is literally teeming with all kinds of fish. The country is poor, low, and unsettled, and the river seems to be a succession of lakes for a long distance. It is said that rockfish are here in great numbers, and are taken during April and May full of eggs.

While the mouth of the Little Pedee is so excellent a place for getting spawn, the Edisto also is a good stream for these fish, and so is the Ogeechee River, near Savannah. At the mouth of Black Creek, a stream that runs by Darlington and empties into the Great Pedee, is a favorite place to fish for rock, and so is a stream on the opposite side of the Pedee, in Marlborough County. Sometimes very large rockfish in considerable numbers are taken, in the spring of the year, by the shad fishermen in the Pedee and Waccamaw Rivers near Georgetown, S. C. Up the rivers in the brackish water the tide extends inland a long distance here.

It is a very gratifying fact that shad have been more plentiful in our Southern waters this year than for twenty-five years before. If this is due to the efforts of the U. S. Fish Commission, the poor people here (white and black) owe it a sincere debt of gratitude.

DARLINGTON C. H., S. C., *May* 22, 1886.

46.—FISH AND FISHING AT ABACO ISLAND.

By WILLARD NYE, Jr.

At this island fish abound. From boats the islanders catch margot, porgies, hogfish, &c., in four fathoms of water, while the groupers and large blackfish are taken in water seven or more fathoms deep. The men go to the fishing-grounds and with water-glasses hunt for a spot where the fish are seen swimming around, which is generally found away from the heavy growth of coral, and on some sand spot where a fine grassy fern-like gorgonian is scattered. For bait, conch or crawfish is used; the latter is most used, although the grouper seems to prefer a piece of fresh fish.

The fishermen generally fish with a water-glass in the left hand and the line in the right, until they have hooked a fish; this is because these fish often take the bait into their mouths without the fisherman being able to feel them with the line. I think a man would catch at least one-fourth more fish with a water-glass than without one. For the same reason (the light way in which the fish bite), a very short snood (from 2 to 5 inches long) is used on the hook and put on several inches above the sinker, so that a very slight pull may be felt. Considerable quantities of grunts, sailor's choice, &c.. are caught with hand-lines by men

too poor to own a boat, who wade out from the shore and fish where the water is three or four feet deep. The best time for this fishing is during a rising tide, just about sunset.

In the deep holes of creeks the mangrove-snapper was seen in such numbers as to make these places resemble the wells of smacks. At one place, under the mangrove roots near the shore, not having a fish-line, I killed 8 of these fish (singly with a shot-gun) that would average 3 pounds apiece.

During the summer months many turtle of the green, loggerhead, and hawk's-bill varieties are caught, either by being speared at or near the surface, caught with jigs while on the bottom, or in tangle-nets around the reefs. Catching them with jigs was new to me, and is done in this way: The jig is made of three or four hooks, about the size of small shark-hooks, fastened to a line which reaches a few inches below and has a sinker made fast to the end. The fisherman goes out in a boat, and when a turtle is seen on the bottom (say in 6 or 7 fathoms) the jig is let down and dragged along until it brings up against him, when a quick jerk will generally fasten it in some soft spot, and the turtle is pulled to the surface.

Turtles are found at and around most of the keys and reefs of the Bahama Islands. They come ashore to deposit their eggs during May and June, and the fishermen assert that they generally lay three times a year. These eggs are much sought after by the islanders, and are considered excellent food. If many more than can be eaten are found, they are sent to Nassau, where they bring about 12 cents a dozen. As the eggs begin to hatch, barracouta, sharks, &c., gather around the reefs in large numbers to feed on the young turtles as they venture out into deep water.

To escape this danger, the young turtles take to the shoals, creeks, and shallow lagoons, where the fishermen catch them during the early fall, pursuing them in boats as they swim along near the bottom. At first it is all that the men can do to row fast enough to keep one in sight, but after a few minutes the turtle becomes exhausted and is easily approached near enough to be speared. These young turtles are delicious eating. I saw none of the regular turtle pegs, the fishermen using mostly an iron or steel headed spear, the head (with line attached) coming off when the turtle was struck; but I noticed they tried not to strike him too hard or near the middle for fear of killing him, and thus preventing preservation for market. If they would use a regular turtle peg this trouble would be entirely done away with. The shell of the hawk's-bill is carried to Nassau, polished, and sold to winter visitors and others, $1.25 being the usual price asked for one 8 inches, and $2.50 for those 12 inches in length.

NEW BEDFORD, MASS., *May* 12, 1886.

47.—SOME RECIPES FOR COOKING FISH.*

ROE CHEESE.—The fishermen of the Dardanelles prepare a kind of cheese from the roe of several kinds of fish by drying it in the air and then pressing it. By dipping it in melted wax a crust is formed over it, which prevents its being affected by the air. Inside this crust the roe undergoes a sort of fermentation, giving it a very piquant flavor, so much so, in fact, that one can eat but little of it at a time. It is said to taste like a mixture of fine sardines, caviare, and old cheese. Before it is eaten the crust of wax is taken off, and if it has become moldy—which frequently happens—it is soaked in strong vinegar.

COOKING FISH.—The Paris Figaro recommends to cook fresh-water fish in a mixture of white wine and water; and salt-water fish in a mixture of water and milk, equal parts, seasoning with salt and pepper.

COOKING FISH IN FAT.—While boiling water, which evaporates freely, keeps a steady temperature of about 212° F., fat can be brought up to a much higher temperature, as its boiling point is about 600° F. For every-day use it is sufficient to heat it to about 400° F. When fish are thrown into such fat a dry, brown crust forms round them immediately, inside of which the meat is soon cooked. The difference between fish cooked in this way and fish fried in a frying-pan is, that the latter, by absorbing a great quantity of fat, lose by evaporation a good deal of the water contained in them, whereby they are fried unevenly and apt to get burned; while the former, owing to the quickly-forming crust, neither absorb the fat nor lose any of their strength. The best fat for this purpose is beef fat, but mutton fat can also be used, after first having been cooked in milk. Olive oil may also be used. Butter, on the other hand, should not be used, partly on account of the water contained in it, and partly because the caseine, when exposed to heat for any length of time, is apt to burn and make it dark.

Beef fat may be prepared by chopping it up in small pieces and boiling it in water until the water has evaporated, all the fat has been rendered, and the threads have become brown and hard. To prevent its burning, it should frequently be stirred after the water has evaporated. The fat is then strained through a cloth and is ready for use.

The following, however, is a better method: After the fat has been chopped fine, it is boiled in water for a quarter of an hour, taken up, and the water squeezed out, whereupon it is again boiled in water for from one-half to one hour. While still hot it is strained through a cloth. When cold the fat will form a cake on the top. The lower side is cleaned, and the fat is melted once more in order to remove any water which it may still contain.

To use the fat a sufficient quantity is placed in a deep pan, not porcelain lined, however, as the porcelain frequently cracks on account of

* From the *Norsk Fiskeritidende*, Vol. V, No. 2, Bergen, April, 1886. Translated from the Danish by HERMAN JACOBSON.

the heat. The fat does not bubble. When a thin bluish steam begins to show itself, or when a drop of water thrown on the fat immediately evaporates with a crackling sound, it has the required temperature. The degree of heat may also be ascertained by sticking the tail of the fish into the fat. If the fat is hot enough the tail becomes brown and brittle in a few seconds. The pieces of fish thrown into the fat first sink to the bottom, but soon rise again. When they are sufficiently brown they are taken out and laid on a perforated board, so that the fat can run off. They should be served immediately, and should not be covered, as the crust soon looses its brittleness. When the fat is not burned it can be used a number of times. If the fish has been rolled in bread, cracker-crumbs, eggs, &c., the fat should be strained every time before it is returned to the vessel in which it is kept, or poured into water, where the impurities will either sink to the bottom or gather at the bottom of the cake of fat, when they can be scraped off.

COOKING PIKE: A RECEIPT FROM THE YEAR 1648.—Take a large pike, make a slit in its belly and take out the entrails with the exception of the liver. Scale and salt the front and hind parts, but leave the scales on the middle part. Lay it in vinegar, so that it gets a nice blue color; then stick it on a spit. Take a clean cloth soaked in wine and tie it around the middle part tightly enough to prevent the fat, with which the two other parts are basted, from entering the middle part. When the fish is on the spit, a mixture, half wine and half water, should be poured on the cloth as soon as it begins to get dry. The front part of the pike should be sprinkled with flour; then hot butter should be poured over it; then again flour, &c., until it is deemed sufficient. The hind part should be sprinkled with ginger and salt, and hot butter should be poured on it from time to time until it is well baked. Care should be taken in putting the fish on the spit, so that it does not break. When ready, serve the fish whole on a flat dish.

SOAKED FISH WITH GREEN PEAS.—After the fish has been well beaten with a wooden mallet, lay it for several days in strong lye, and then in soft water, until it has become completely soaked. Before it is used it should be soaked for a good while in warm salt water, but not boiled. The peas are cooked in a little water with salt and butter, a little flour is added, and they are boiled up once more with chopped parsley.

FRESH HERRING WITH BROWN SAUCE.—The herring are cleaned and sprinkled with salt half an hour before they are used. They are then dried in a cloth, rolled in flour or bread-crumbs, and fried in butter or lard. For the sauce take a medium-sized onion, about ¼ pound of lean bacon, some pepper ground fine, a table-spoonful of flour, and two table-spoonfuls of good vinegar. The onion is chopped fine and steamed until it has become quite soft, and the bacon is added cut in small cubes; finally the flour is stirred in. Then add 1 pint of water, and boil the whole until you have an evenly thick brown sauce, which is poured over the fish.

Vol. VI, No. 9. Washington, D. C. June 21, 1886.

48.—NOTES UPON FISH AND THE FISHERIES.

[Extracted from the official correspondence and compiled by the editor.]

WHITEFISH AND LAKE TROUT EGGS SENT TO SWITZERLAND.—The minister of Switzerland, Col. Emile Frey, under date of Washington, February 15, 1886, writes that the 1,000,000 eggs of the *Coregonus albus* and the 50,000 eggs of the lake trout have reached Switzerland in the very best condition, and have been distributed for hatching as follows:

Hatchery.	Coregonus albus.	Lake trout.
Zurich	200,000	10,000
Zug	200,000	10,000
Geneva	200,000	10,000
Locarno	125,000	10,000
Interlaken	100,000	10,000
Lucerne	100,000	....
Brassus	25,000	....
Saint Moritz	20,000	....
Stanz	20,000	....
Chur	10,000	....
	1,000,000	50,000

AMERICAN FISH EGGS IN ENGLAND.—The ova with which the U. S. Fish Commission has supplied our National Fish Culture Association have hatched out well, and the fry are progressing rapidly. The fish from last year's ova are doing very well. Also I have hatched out a large number of whitefish from some of the ova sent to the Association and forwarded to me from South Kensington by Mr. Chambers. [Marquis of Exeter, Burghley House, Stamford, England, April 2, 1886.]

INCLOSURES FOR SALMON IN THE NETHERLANDS.—In the Fish Commission Bulletin for 1884, p. 170, there was printed a statement by Mr. Charles G. Atkins relating to penning salmon at Bucksport, Me. This was in response to a request of Dr. C. J. Bottemanne for information on this subject. In a pamphlet, dated at Bergen-op-Zoom, Netherlands, November, 1885, Dr. Bottemanne cites almost in full the statement by Mr. Atkins, and adds other matter substantially as follows:

For years complaints have been heard from various persons in the Netherlands that many of the salmon eggs ordered from Germany failed to hatch successfully, and that the prices were too high. As we knew that successful efforts had been made in the United States to pen salmon and then obtain the eggs from them at the spawning time, we learned the methods of doing this, with a view to applying these to salmon breeding

in the Netherlands. After careful consideration, I do not know of a single reason why we should not obtain the same or even better results than have been obtained in America.

There is but little chance for obtaining salmon in America after July, while in the Netherlands they can be obtained, and cheaply, for six weeks after this date. With us the transportation to the inclosure will be easy, as the great fisheries are carried on in the lower portions of the rivers, and the fish could quickly be transported by water to the penning places. The inclosures, also, should be made as near as possible to the sea, so that the water may be brackish if not salt. Salt water seems to have a healing influence on the wounds of salmon, and it is probable that in salt water they will remain free from parasitic growths, as experiments with young salmon seem to indicate that salt is an efficient remedy against this trouble. In an experiment made by myself I used well-water, containing considerable salt, for hatching 1,000 salmon eggs, with a remarkably small loss of young fish.

POISONOUS FISH IN CHINA.—In the Chinese Recorder of February and April, 1886, there appeared two articles by D. J. Macgowan, M. D., of Wenchow, Province of Che-Kiang, China, which furnished the material for the following abstract:

The flesh of the porpoise is highly prized for its flavor, and yet under certain circumstances it is much condemned for poisonous qualities. Animals seem more liable to be killed by it than human beings; but many instances of death among the Chinese from eating this flesh are related. Although some magistrates from time to time issue proclamations cautioning the people against the use of porpoise flesh, scarcely a spring passes without fatal cases of poisoning. The Shenpao lately reported eleven deaths that occurred at Yangchow from this cause, and five persons died at Anching in April from eating this flesh. On the sea-coast, or early in the spring, poisonous cases are very rare. In Suchow this flesh is generally eaten, and I have heard of no deaths therefrom during several decades. This is probably not that as food this is there less harmful, but that it is more thoroughly cooked. On the Che-Kiang coast dried porpoise is sold all the year round by fishmongers, but it requires protracted boiling in order to become safe for eating. The Chinese olive or sugar-cane (*Canarium*) is found to be an antidote for this poisoning, while long-continued boiling is considered to make the flesh wholesome.

In Chinese waters there are several kinds of fish that inflict troublesome wounds by means of their fins or tails. The tetrodon or globe-fish is rejected by coast fishermen as poisonous; but those globe-fish that ascend the rivers, when properly cleaned and dried, are fit for food. A kind of mud-fish is regarded as hurtful. So also are several kinds of eels. Oysters, in China as elsewhere, are considered unfit to eat at certain seasons. Some crustaceans, including field and ditch prawns, are thought to be poisonous.

In China fish are often killed or stupefied by using poisonous preparations made from a species of *Polygonum*, or the seeds of the *Croton tiglium*, or other vegetable substances. This practice is of very long standing, and is occasionally prohibited by the magistrates.

American clams in England.*—Some time ago the Marquis of Exeter undertook to acclimatize American mollusks. In the fall of 1884, Mr. George Shepard Page, of New York, sent him some quahogs or hard clams (*Mercenaria violacea*), which died before arriving at Liverpool. In February, 1885, another attempt was made, which was a great success. On March 16, 1885, Mr. Henry Wright, secretary to the Marquis of Exeter, wrote to Mr. Page that these quahogs had this time arrived in perfect condition, and that, as soon as they were deposited on the soft sand of the seashore, they dug their way into the sand with an activity which showed they had suffered nothing from the voyage. He now wishes a lot of sand clams or soft-shelled clams (*Mya arenaria*).

Codfish in the Pacific.—Mr. James G. Swan, writing from Port Townsend, Wash., April 6, 1886, says: "I can report that true cod have made their appearance in the harbors of Port Angeles and Port Discovery in considerable numbers during the past two months, and probably they will be in Port Townsend harbor in May. Three years ago I observed young cod, from 2 to 3 inches long, in a net among herring, smelts, and other small fish. The next year cod as large as tomcod were very plentiful here. Those taken in the summer of 1885 were from 12 to 18 inches long; and this year they are from 20 to 36 inches in length, and over. They are lean, not having attained full growth, but are of very good flavor. I have not observed any spawn in the specimens that I have examined."

Shipment of marine products from San Francisco to China.—The Sacramento Record of April 6 states that the efforts of the fish commissioners in placing fry in the public waters are being utilized by the Chinamen, who fish with nets in which they gather enormous quantities of very small fishes for exportation; and the following figures are given of the amount and value of the products so exported:

150 tons of shrimps, at $300	$45,000
200 tons of small salmon and other fry, at $200	40,000
50 tons of shrimp shells and fish manure, at $40	2,000
Total value of each shipment	87,000
3 shipments per month	261,000
36 shipments per year	3,132,000

Mussel culture in France.—In connection with the oyster-cultural exhibition recently organized in the Palace of Industry at Paris, there has been occasion to speak of the mussel (*Mytilus edulis*), which invades the oyster-beds after they have been properly arranged, and proves very injurious to the oysters. The French oyster-culturists wage war on these mussels by means of the starfish, which is destructive to them.

* Translated from the *Moniteur de la Pisciculture*, &c., of March 13, 1886.

The mussel, which, on the French coasts, generally lives in great numbers on rocks left bare at low tide, is in the North Sea the object of an important industry, which may be compared with the French oyster-culture. Especially in the bay of Kiel (coast of Holstein, on the Baltic Sea) near Ellerbeck and Dusternbrook, where it finds conditions very favorable to its development, it is cultivated artificially and reared in parcs in a peculiar way. Its cultivators plant near the shore actual groves of trees—such as alders, oaks, or beeches—stripped of their small branches and driven 10 or 12 feet into the bottom. The mussels fasten on these branchless trees, develop there, and in winter are gathered periodically in abundance. These trees are planted in such a depth of water that they are never uncovered even by the lowest tides, while their exact position is determined by means of fixed marks on the shore. In order to gather the mussels, they haul up the trees by means of a rope attached to a capstan. This takes place from three to five years after the trees have been put down. It is only during the past few years that this cultivation has been carried on regularly in the bay of Kiel, and it has resulted in products remarkable both for size and quality. In that region a tree properly prepared costs about 25 cents, and at collection it easily yields 55 pounds of mussels, worth on the spot an average of $2.50. On some points of the Mediterranean coast the same industry is practiced, using stakes joined in hurdles by means of bundles of sticks or by means of stout sea-weed. [Max de Nansouty, in the *Moniteur de la Pisciculture*, Paris, December 5, 1885.]

DEVELOPING THE FISHERIES OF WASHINGTON TERRITORY.—The following memorial, after passing the legislature of Washington Territory, was approved by the governor on January 29, 1886:

To the Senate and House of Representatives of the United States in Congress assembled:

Your memorialists, the legislative assembly of the Territory of Washington, respectfully represent that the United States Fish Commission, by liberal appropriations granted by Congress, have been and still are doing a great and valuable work on the Atlantic coast of the United States in developing the food-fishes and other marine food products of the Atlantic Ocean, and have, therefore, added largely to the national wealth.

Your memorialists further represent that the waters of Puget Sound present conditions favorable to the propagation of lobsters and varieties of oysters, and contain within the deep channels and fiords new and valuable varieties of food-fishes which, although known to exist, have never been properly developed, from want of funds and requisite knowledge and experience, which knowledge and experience are possessed by the United States Fish Commission in a greater degree than by any private individuals in this Territory.

Wherefore your memorialists respectfully pray that the sum of

$10,000 be appropriated for the purpose of developing the fisheries of Washington Territory, and that said amount of $10,000 be expended by and under the direction of the United States Fish Commission in introducing the best varieties of food-fishes, lobsters, and oysters into the waters of this Territory wherever, in the judgment of said Fish Commission, they may best be placed to propagate, and also to develop the marine food products already existing and native to these waters.

SALMON, LAKE TROUT, AND BROWN TROUT AT GLENS FALLS.—On April 28, 1886, the fry of 30,000 lake trout, 20,000 Penobscot salmon, and 8,000 brown or European trout reached Glens Falls, N. Y., from the Cold Spring Harbor station. These fry were from ½ to 1½ inches in length, and had made the journey with very slight loss. The lake trout were planted in Lake George, being the first of this kind brought to this locality, at a place called the "Calf-pen," opposite Dome Island, where there is the deepest water of the lake. The brown trout fry came from spawn presented to Mr. E. G. Blackford and Mr. Fred Mather by the German Fishery Association, and are the first of their species planted in this vicinity, being put in the Clendon Brook. This species is common in suitable European trout-streams, where it has attained the weight of 16 pounds. It is said to grow faster and be more hardy than our native trout. The salmon also were planted in the Clendon Brook, from which it is hoped they will stock the Hudson River. This is the third consignment of salmon to the Clendon Brook in three consecutive years, and makes about 140,000 of this fish that have been planted there; and it is hoped that some of the earlier plantings will return this year for the purpose of spawning. [From the Glens Falls Republican, May 4, 1884.]

INCREASE OF CALIFORNIA TROUT.—The increase of so-called California trout, which are in reality the rainbow trout, has been immense. There are now 7,000 in the preserves, all from the 500 eggs presented to the South Side Sportsmen's Club by Professor Baird six years ago. The club has just sold 1,000 1-pound fish of this variety to Mr. Pierre Lorillard for the the stocking of Tuxedo Lake. The fish law admits of the rainbow trout being taken in this State between the 1st of September and the 1st of May. They are now for the first time about to be placed on the market by Fish Commissioner Blackford, who has arranged with the club for a supply. The fish weigh from 8 ounces to 2 pounds each, and will be served by Delmonico and the Hoffman House on Monday. It costs the club $1,800 a year to feed its trout. They are fed on livers from Senator McPherson's abattoir in Jersey City. [From the New York Sun, December 19, 1885.]

RAINBOW TROUT, EELS, AND HATCHING OF CARP.—Mr. J. S. Tuttle, writing from Niles, Mich., June 4, 1886, says:

This spring I made my first attempt at taking the eggs of the rainbow trout, which hatched for me in about thirty days. The small streams in this part of the State (southwestern corner, near Lake Michigan) are being well stocked with trout.

In one pond I have yearling trout, and thinking they were disappearing rather rapidly, on June 3 I cleaned out the pond, finding two eels weighing about 2½ pounds apiece, which I put into a can. Coming to take them out an hour afterwards I was surprised to find that they had disgorged two partly digested fish 6 or 7 inches long, which probably they had swallowed four or five hours previously.

In Hessel's pamphlet on carp it is stated that the eggs hatch in from twelve to sixteen days.* My experience this year seems to reduce this time by one-half. I have raised carp with success for three years. This year, on May 18 I filled my pond with water; on the 19th put in 24 large carp, which began spawning on the morning of the 21st; and on the 24th it became cooler and spawning ceased for the time. On the morning of May 27, six days after spawning began, there were about 10,000 young fish along the edges of the hatching pond, to which the eggs and brush had been transferred the day before; and on the 29th there were probably from 15,000 to 18,000 young carp.

LAKE TROUT IN COLORADO.—I find that the few lake trout that have been tried in the prairie lakes are a success, and if you will send me 10,000 eggs, I will put up another trough to hatch them. [John Pierce, Denver, Colo., December 3, 1885.]

SOUTH SIDE SPORTSMEN'S CLUB.—We have had a very successful winter's work in our fish hatching department, nearly a million eggs of brook trout having been hatched, and there are about 50,000 rainbow trout eggs now on the trays. We have 6,000 three-year-old trout in the ponds and streams. [Roland Redmond, March 25, 1886.]

CARP IN RIVANNA RIVER.—Anderson Brown, colored, caught out of Rivanna River [probably in the neighborhood of Charlottesville, Va.], with a hook, a German carp which weighed 6½ pounds and measured 24 inches in length and 16 in circumference. [From the Lynchburg Advance, September 17, 1885.]

CARP IN RIVANNA RIVER.—Carp are now being caught in the Rivanna River which are supposed to be fugitives from the ponds of myself and others. Some time since one weighing 6½ pounds was taken, and yesterday one of 8½ pounds. [R. T. W. Duke, Charlottesville, Va., April 29, 1886.]

TO COOK CARP.—Carp may be either fried or stewed. Have them cleaned nicely, then dry them and season with salt, pepper, and a little mace, which rub in thoroughly, and let them lie in melted butter for an hour or two before cooking them. Fry them the usual way. To stew them put them into a saucepan with some chopped parsley, a whole onion, a little sweet marjoram, a teacupful of rich milk (or cream if you have it), and a lump of butter rolled in flour. Pour on this sufficient water to cover the carp and let it stew gently for about half an hour, or until the flesh leaves the bones easily. Some consider that a little port wine improves it.

* See F. C. Report, 1875-'76, p. 872.

*Table of German carp planted in public waters of the United States, November 4, 1885, to January 5, 1886, inclusive, under the direction of Col. M. McDonald, Chief of the Division of Distribution, U. S. Fish Commission.**

State.	Date.	Place at or near which.	Waters stocked.	Number of fish.
Alabama	Dec. 8, 1885	On line of railroad	Lake on line of Atlanta and West Point Railroad.	500
Arkansas	Dec. 29, 1885	Fulton	Red River	3,200
Colorado	Dec. 20, 1885	Granada	Arkansas River	5,000
Delaware	Dec. 10, 1885	Wilmington	Brandywine Creek	500
	Dec. 10, 1885	Wilmington	Christiana Creek	500
	Dec. 10, 1885	Wilmington	Delaware River	500
	Dec. 10, 1885	Wilmington	Shellpot Creek	500
Florida	Dec. 5, 1885	Jacksonville	Lakes near Jacksonville	600
Georgia	Dec. 11, 1885	Way Cross	Satilla River	2,400
Illinois	Jan. 2, 1886	Aurora	Fox River	1,000
	Dec. 30, 1885	Carlyle	Kaskaskia River	400
	Jan. 2, 1886	Chicago	Lakes in Lincoln Park	1,600
	Jan. 2, 1886	Chicago	Lakes in South Park	1,050
	Dec. 30, 1885	Clinton	Water-tank on Illinois Central Railroad.	200
	Jan. 1, 1886	Dixon	Rock River	1,000
	Dec. 30, 1885	Equality	Saline River	400
	Jan. 2, 1886	Kankakee	Kankakee River	1,000
	Dec. 30, 1885	Lanesville	Lanesville Lake	800
	Jan. 1, 1886	La Salle	Illinois River	3,000
	Dec. 30, 1885	Louisville	Little Wabash River	200
	Jan. 1, 1886	Mendota	Little Vermilion River	1,000
	Dec. 30, 1885	Mill Shoals	Little Wabash River	400
	Jan. 2, 1886	Naperville	Des Plaines River	200
	Dec. 30, 1885	Pekin	Lake Cooper	100
	Dec. 30, 1885	Riverton	Sangamon River	1,000
	Dec. 30, 1885	Vandalia	Kaskaskia River	1,000
	Dec. 30, 1885	Wood Lawn	Big Muddy River	400
Louisiana	Dec. 7, 1885	La Fourche	Bayou La Fourche	1,000
	Jan. 5, 1886	Monroe	Washita River	2,000
	Jan. 5, 1886	Quebec	Tensas River	1,000
	Jan. 5, 1886	Rayville	Crew Lake	1,000
	Jan. 5, 1886	Richland County	Grassy Lake	1,000
	Dec. 10, 1885	Shreveport	Red River	2,500
	Jan. 5, 1886	Tallulah	Lake One	1,000
Maryland	Nov. 17, 1885	Battery Station	Susquehanna River	20,000
Minnesota	Nov. 4, 1885	Slayton	Lake Beauty	500
Mississippi	Jan. 5, 1886	Jackson	Pearl River	5,000
New México	Dec. 21, 1885	Albuquerque	Rio Grande River	6,000
Tennessee	Nov. 28, 1885	Dyersburgh	North fork of Forked Deer River.	1,000
	Nov. 30, 1885	Fowlkes	Tributary of Forked Deer River.	1,000
Texas	Dec. 12, 1885	San Marcos	San Marcos River	5,050
Virginia	Dec. 4, 1885	Brooke's Station	Acquia Creek	6,250
	Nov. 24, 1885	Charlottesville	Ivy Creek	400
	Nov. 24, 1885	Charlottesville	Rivanna River	1,600
	Dec. 23, 1885	Chatham	Banister River	3,000
	Dec. 23, 1885	Danville	Dan River	6,000
	Nov. 28, 1885	Junction	North Anna River	7,000
	Dec. 23, 1885	Lynch's Station	Staunton River	6,000
	Nov. 27, 1885	Milford	Mattapony River	8,000
	Dec. 23, 1885	Otter River	Otter River	5,000
	Dec. 4, 1885	Potomac	Potomac River	5,500
	Dec. 4, 1885	Quantico	Quantico Creek	6,250
	Nov. 15, 1885	Rockfish Depot	Rockfish Creek	200
	Nov. 28, 1885	Taylorsville	Little River	5,000
	Nov. 28, 1885	Taylorsville	South Anna River	5,000
	Dec. 4, 1885	Wood Bridge	Occoquan River	7,000
		Total number planted		148,700

*Compiled from Colonel McDonald's report for 1885.

CATCHING CARP WITH A HOOK.—Carp can easily be caught with a hook if baited with anything they are accustomed to feed upon. A tough crust of bread or a small ball of cotton thoroughly saturated with dough can easily be fastened to a hook and will answer the purpose very well. [Amos Ebert, Ashland, N. J., May 8, 1886.]

TIME REQUIRED FOR HATCHING CARP EGGS.—Procuring a number of eggs, immediately after the fish had cast them, in June, 1885, I placed

them in an ordinary pint jar, filled with water from the pond. In searching for the eggs, I found them adhering to the stems of water-rice, and water-weed (*Anacharis*), chiefly to the latter. The jar containing them was placed in a position where it would be shaded at midday, but have the sun mornings and evenings. On the fourth morning I examined the jar, and to my surprise found several of the little fish already hatched, seemingly active and vigorous.

A few days after, while the fish were in the act of spawning, I procured eleven eggs and placed them in the same jar. These were taken from a different portion of the pond, and were found adhering to the hornwort (*Ceratophyllum*). The jar containing the eggs was nearly filled with water, and put in the pond, so placed that the surrounding water came nearly to the top. I examined it twice a day. In fifty-seven hours the outlines of the head became visible; the eyes and fins also could be distinctly seen. On the morning of the fourth day, or ninety-six hours after the eggs had been cast, the little fish had made their appearance, and showed much vigor in their movements. Three days later I emptied the jar, and found four fish as the product of the eleven eggs. Only about 36 per cent of the eggs had hatched. Probably the rest had not been fertilized. Considering the hap-hazard manner in which fertilization takes place, it would not be strange if many of the eggs were not reached by the milt. On the second day one of the eggs became surrounded by a kind of fungous growth, it evidently having not been fertilized, and very soon decay set in. A fortunate snail discovered it, and was not long in making a meal of it. [John H. Brakeley, Bordentown, N. J., April 6, 1886.]

Food of carp.—Dr. P. Brocchi says, in an article reprinted in the French *Moniteur de la Pisciculture* for January 30, 1886, that as carp are vegetable-eaters, one should not dream of feeding them on beef's blood, the offal of slaughter-houses, or even on cooked and finely hashed meat.

Eels.—In regard to eels, Dr. Brocchi says, in the same place, that they are essentially carnivorous, and that owing to their form and muscular strength they can penetrate into fissures and slight cracks, and to some extent into the banks of a pond, but that they thus do no serious damage. To keep them in a pond he suggests putting along its edges a wide strip of fine sand, but says that they are not likely to wander much if they find sufficient food in the pond.

Shad appearance.—The shad have again made their appearance off North Truro, Mass. About 20 were received to-day. [E. G. Blackford, October 22, 1885.]

Appearance of menhaden.—The first appearance of menhaden coming to my notice was on the 5th of April. They were taken in a net by a fisherman in the bay upon which this station is located, about 25 miles from Chincoteague Inlet. [Adelbert Soper, keeper of North Beach life-saving station, Berlin, Md.]

A LARGE CATCH OF MACKEREL.—It was reported in the Boston papers of October 17, 1885, that Capt. Melvin McLain, of the schooner Henry Dennis, had arrived at that market with 82,500 fresh mackerel, which were sold for $2,268.75, having been taken in less than half an hour in Barnstable Bay, 8 miles from Plymouth, Mass.

MOVEMENTS OF MACKEREL.—No mackerel have been caught in this vicinity, to my knowledge, since November 2. I have never known mackerel so large, fat, and plentiful as they were in this vicinity during the month of July. [John F. Holmes, keeper of Gurnet's life-saving station, Plymouth, Mass., November 20, 1885.]

HATCHING AND PLANTING ROCKFISH.—An instalment of young rockfish, the first hatched at the Havre de Grace station, was transferred by messenger F. L. Donnelly to Oswego, N. Y., and successfully planted in Lake Ontario, near the mouth of Oswego River, on the evening of May 15, 1886. They were transported in cans, 20,000 being assigned to each can, the water being kept at an average temperature of 50° F. J. B. McMurrich, vice-president of the Leatherstocking Club, and N. A. Wright, president of the Ontario Fishing Society, met the consignment at the depot in Oswego, and were much pleased at the fine condition of the fish after their trip of twenty-seven hours.

APPEARANCE OF WHITING OR FROST-FISH.—Whiting, or, as we call them, frost-fish, struck on in great quantities about the 1st of November, and have been around ever since. Every night the shore is lined with the lanterns of the boys and men who are spearing them. Squilla have been more plentiful in the river than I ever knew them to be before. [Willard Nye, jr., New Bedford, Mass., November 23, 1885.]

CULTIVATING CATFISH.—Some thirty years ago I owned a farm near Paris, Bourbon County, Kentucky, on which I experimented with catfish. Having drawn off the pond, I removed the turtles, gars, and other animals, and put back nearly half a barrel of young catfish, a few bass, and some sunfish. I then began to feed the fish on soft corn dough made from shorts, and occasionally on beef cut in strips. After a few weeks these fish became accustomed to coming to the edge of the pond for this food, and, as a result of gentle treatment, the large ones would often come so near that their fins would project out of the water. Within a year I had all the fine fish I could use, besides supplying six or eight families of neighbors. I raised catfish weighing six or seven pounds and measuring two feet in length. [Naman May, Arnold, Labette County, Kansas, February 3, 1886.]

STRIPED BASS.—A large striped bass (*Roccus lineatus*) was caught in a net through the ice, in the Hudson River, at or near Croton Landing, N. Y., on February 1, 1886. This is the largest fish of the kind reported this season. It weighed 55 pounds, and was displayed at Mr. E. G. Blackford's, in Fulton Market, New York City.

EARLY SHAD.—The first North River shad was taken to-day at Yonkers. [E. G. Blackford, March 23, 1886.]

LARGE WHITEFISH.—A short time ago I secured a whitefish weighing 18 pounds. [Alexander McQueen, inspector of fisheries, Winnipeg, Manitoba, April 3, 1886.]

DECREASE IN THE FISHERIES OF MALTA.—Referring to page 400 of the U. S. F. C. Bulletin for 1885, on the subject of the falling off in the fisheries of Malta, I beg to state that when stationed there, as far back as 1858 to 1862, it was the general practice for fishermen to use immense seines, requiring from twenty to forty men to haul them in, and when shot extending across the harbors. The mesh of the purses of these seines was so small that the minutest fry could not possibly escape. To this I attribute the cause of the continual annual decrease of fish in those waters. The same system is carried out in other parts of the Mediterranean. [Capt. George Pittendrigh, New Westminster, British Columbia, June 21, 1886.]

AMERICAN CATFISH IN FRANCE.—In his annual report on the doings of the French National Acclimatization Society in 1885, the secretary, C. Raveret-Wattel, stated that during the year a valuable shipment from Prof. S. F. Baird had enabled the society to attempt the acclimatization of the catfish of North America (*Amiurus nebulosus*). This fish, he said, merits special attention, in that it thrives in stagnant and even muddy waters; and that, being hardy and of great fecundity, it will be an excellent acquisition for stocking ditches and pools, where it succeeds wonderfully, while the indigenous fish scarcely amount to anything. [From the Bulletin of the Society for July, 1886, p. xlvi.]

MEDAL TO E. G. BLACKFORD.—For several years now the society has received from the United States fertilized eggs of salmonoids through the kind assistance of Mr. Blackford. In 1885 a shipment of the eggs of the rainbow trout (*Salmo irideus*) was received, owing to his excellent co-operation. The society desires to return thanks to Mr. Blackford for his services, and awards to him a medal of the first class. [From the *Bulletin de la Société Nationale d'Acclimatation de France*, Paris, July, 1886, p. lxiii.]

PLANTING LANDLOCKED SALMON IN PENNSYLVANIA.—Mr. John A. Harper writes from Pittsburgh, Pa., June 26, 1886, as follows: "I recently placed about 12,000 landlocked salmon in the streams flowing into the lake of the South Fork Fishing and Hunting Club, in Cambria County, Pennsylvania. The fish were a lively, healthy lot of little fellows, each about 1½ inches long. They were transported, owing to the special attention given to them by Mr. Buller, superintendent of the State hatchery at Corry, from the hatchery to the lake with the loss of less than a dozen fish. This seems remarkable, as the journey from Corry to the lake is about 250 miles, and to accomplish it several changes of railroad cars were made, and there was a three-mile haul over a very rough mountain road, with boat and portage, to the small streams up in the woods. The fish were hatched from eggs received from Maine early this spring, by order of Professor Baird, and in response to a request made more

than a year ago. They have been cared for by our State commission at the hatchery at Corry until delivered to me on June 22."

CANNED-SALMON TRADE.—Salmon are caught and canned on the Sacramento River in this State, on seven rivers in Oregon, on Puget Sound and the Chehalis River in Washington Territory, on Alert Bay and the Fraser and Skeena Rivers in British Columbia, and one or more rivers in Alaska. More than one-half of the quantity packed must be credited to the Columbia River. Carefully compiled statistics by Field & Stone show the pack of 1885 to have been as follows:

	Cases.
California	48,500
Oregon	592,200
Washington Territory	13,300
Alaska	74,850
British Columbia	106,865
Total pack, 1885	835,715
Total pack, 1884	985,295
Decrease in 1885	149,580

The decrease in production and the losses by sea, amounting to 102,086 cases, have put the market on a better basis than it has been for three years. [Weekly Bulletin, San Francisco, February 24, 1886.]

A LARGE SALMON.—On January 31, 1885, an unusually large salmon was taken at Woudrichem, weighing 58½ pounds, and measuring 51 inches in length and about 29½ inches in circumference. It was sold for $33.25. [From the Journal of the Society for the Promotion of the Fresh-water Fisheries in the Netherlands, Amsterdam, December 4, 1885.]

SALMON SOLD AT BILLINGSGATE.—The sixth annual report by the council to the members of the Scotch Fisheries Improvement Association, May, 1886, gives in an appendix the figures from which the following table is extracted. The table was compiled from returns furnished by Forbes, Stewart & Co., showing the amount of salmon sold at the Billingsgate (London) market during the ten years preceding 1886. The returns were given in boxes, and have been reduced to pounds on the basis of 100 pounds to the box.

Years.	Pounds of salmon.	Years.	Pounds of salmon.
1876	3,919,700	1882	3,329,600
1877	4,000,800	1883	5,093,500
1878	3,622,700	1884	3,930,000
1879	2,485,000	1885	4,637,400
1880	3,182,500		
1881	3,945,800	Total	38,147,000

EELS CONSUMED IN ENGLAND.—In London and vicinity over 3,250,000 pounds of eels, valued at $650,000, were consumed last year. About 800,000 pounds additional passed through the markets. Of the total

amount about 2,000,000 pounds came from Holland, 1,000,000 pounds from Germany, 1,000,000 pounds from Ireland, 100,000 pounds from Scotland, and only a small quantity from the waters of England.

SPONGE FISHING NEAR APPALACHICOLA, FLA.—Mr. John E. Grady, collector, writing from the custom-house at Appalachicola, Fla., on July 21, 1886, states that the sponge fishing near there is all done considerably more than 3 miles from land. The value of $1.75 per pound is about the amount the sponge buyers intend that the sponges shall cost them, as purchased from the vessels immediately on arrival. No sponges are sold here or anywhere by the sponge catchers by the lot. The spongers string their sponges on yarns or tarred strings of 6 feet in length, and on arriving at port the lot is then carefully counted and thrown into a pile. The sponge buyers are notified, and they examine the size and quality of the sponges, and also the length of the strings or yarns on which the sponges are placed. The sponge catcher guarantees only that a certain number of bunches is in the lot or pile. Each dealer then has three sealed bids, which are submitted to a disinterested party, and the highest takes the sponges, as the owners bind themselves to accept the highest bid.

SEA-LIONS ON THE COAST OF OREGON.—Mr. Zachary T. Siglin, deputy collector, writing from the custom-house at Coos Bay, Oregon, on July 8, 1886, states that there are no vessels of that district (Southern Oregon) engaged in deep-sea or outside fishing, but that the fishing of the district is carried on only in the rivers and bays, and is confined entirely to salmon. The fishing season will begin about the middle of August. However, the schooner Ruby has recently engaged in the business of killing sea-lions for their oil, and also for the purpose of destroying them, as they are a great enemy of the fish. This hunting of the sea-lion is done at the entrance of the rivers and bays, where they are found in great numbers, and if not destroyed it is generally believed that they prevent the fish from coming in.

CALIFORNIA TROUT IN HOLSTON RIVER AND IN TRIBUTARIES OF NEW RIVER.—Mr. W. C. Pendleton, of Marion, Va., who is clerk of the supreme court of appeals at Wytheville, Va., states that citizens are catching some very fine California trout out of the Holston River. He has seen six of them which averaged 18½ inches. These fish were planted in the Holston, at Marion, in March, 1884, and were yearlings when released. Tate's Run, adjacent to the Wytheville hatchery, is pretty well stocked with these fish; every few days some are being caught above here. [George A. Seagle, superintendent of Wytheville Station, Va., in letter to Col. M. McDonald, dated June 15, 1886.]

DEAD FISH IN SHALLOTTE RIVER, NORTH CAROLINA.—Great multitudes of fish have recently been found dead in the waters of Shallotte River, Brunswick County, North Carolina. This stream empties into Tubb's Inlet from the ocean, about 30 miles southwest of Wilmington. The water is covered by an oily scum, which extends far out into the

ocean, and has been noticed 5 miles from the beach. [From the Washington Post, Washington, D. C., June 27, 1886.]

SHAD IN THE OHIO RIVER.—Shad have occasionally been caught here for three, and some say for four, years. They are generally taken near the falls or rapids of the Ohio, in nets and seines, both above and below the falls. Local experts pronounce them Potomac shad. They are caught in the spring whenever the water is low enough to fish with set-nets and seines. In weight they run from ½ to 3½ pounds. Several dozen have been sold in the markets here and in Louisville, Ky. (just across the river), each season for several years. [J. P. Applegate, New Albany, Ind., June 23, 1886.]

FISH AND OYSTER TRADE OF BRASHEAR, LA.—I herewith send the amount of oysters and fish shipped from this port for the period of eight months, from September 1, 1885, to April 30, 1886:

	Number.
Oysters, open	8,513,239
Oysters, in shell	1,799,815
Total	10,313,054

These oysters were shipped entirely by Wells, Fargo & Co.'s Express per rail to Texas and California, and in addition about 2,000,000 were shipped by steamers to Galveston, in shell and open. They are taken on the Gulf coast eastward of this port, and the business furnishes employment to a large number of owners of small luggers, most of which are under 5 tons burden.

There have also been shipped from this port, in the time mentioned, about 321,785 pounds of catfish, which are caught in the Atchafalaya River, and adjacent bayous. [William T. Carrington, Collector of customs, Brashear, La., June 21, 1886.]

CODFISH ON THE PACIFIC COAST.*—Mr. James G. Swan, writing from Port Townsend, Wash., on July 9, 1886, states as follows: "This summer there has been an abundance of true cod in Port Discovery Bay. One or two persons have pickled a few barrels, but many tons have been thrown away for want of knowing how to dispose of them. This year the cod taken here are of almost mature growth, and next year they will spawn. I have made diligent inquiry among the white fishermen and Indians, and fail to find that the cod taken this season had any spawn. One fisherman told me that he caught a large female cod last December full of spawn, but that this was the only one he noticed. The fact that they have again come upon our coast here is of much interest. They have been more plentiful this season than at any other time since 1859-'60, when they were very abundant. The next year none were taken, and the cod seemed to have disappeared from our waters, and since then until recently only an occasional one has been seen in the fish-markets of Victoria, B. C., and Port Townsend."

* See also F. C. Bulletin for 1886, p. 131.

List of vessels employed in the Potomac River fisheries from March 31 to May 31, 1886, and belonging in the customs district of Alexandria, Va.

[Furnished by B. H. Lambert, deputy collector, June 18, 1886.]

Rig.	Name of vessel.	Home port.	Name of master.	Name of principal fishing place.	Number of men employed.	Tonnage, in tons and hundredths.
Sloop	Daniel Sheets	Alexandria, Va	J. T. Southard	The Gums	2	10.21
Schr	Jeanette	do	Richard Raymond	Mattawoman	2	11.73
Do	Empire	Georgetown, D. C.	—— Bell	do	2	9.10
Do	Discovery	Tappahannock, Va.	L. E. Headley	do	3	18.93
Do	Cora L. McKenney.	Alexandria, Va	Charles McKenney.	Quantico	3	21.69
Do	Azalia H. Peart	do	James H. Beach, jr.	do	3	19.18
Sloop	Belvidere	do	Richard Johnson	do	2	10.77
Schr	Annie Gibson	do	Charles Kelly	Wade's Bay	3	16.05
Do	Miami	do	Webb Maddux	do	3	21.86
Do	Kitty Ann	do	William Lacock	Richland	3	27.69
Do	Henry F. Adams.	Crisfield, Md	—— McLaughlin	do	2	8.86
Do	William L. Ellis		Charles M. Simpson.	do	2	5.00
Do	Ella L. Vetra	Crisfield, Md	John M. Todd	do	2	10.07
Do	Caroline	Alexandria, Va	Peter Frances	White Point	3	14.34
Do	Flora	do	Augustus Dean	Acquia Creek	2	13.71
Do	S. Chase	Crisfield, Md	—— Price	do	3	15.22
Do	J. W. Brooks	Tappahannock, Va.	L. J. Beatly	Great Wicomico	3	47.74
Do	Lillian Frances		J. T. Rowe	Deal's Island	2	5.00
Do	Four Sisters	Crisfield, Md	N. W. Todd	Wicomico	2	12.47
Sloop	Emma C. Berry	New London, Conn.	William O. Chassey.	St. George's Island	3	15.76
Schr	Virginia	Onancock, Va	—— Simpson	do	2	5.47
Do	Charles Lewis	Alexandria, Va	J. H. Beach	Hollowing Point	3	22.26
Do	Margaret Ella	do	James Hall	do	3	16.19
Do	Leading Breeze	Crisfield, Md	—— Savage	White House	3	26.29
Do	Leona	do	John W. Todd	do	2	8.83
Do	Zareta	do	William Dashield	Mattox Creek	2	9.69
Do	Dove	Tappahannock, Va.	L. J. Rowe	Chapman's Point	3	17.22
Do	Thomas E. Parks		Joe Arnold	Washington Beach.	2	5.00
Do	Mary Ellen	Town Creek, Md	—— Poe	St. Mary's, Md	3	13.61
Sloop	Carrie P. Gambrill		Benjamin Lewis	Chapman's Point	2	....
Schr	Lizzie Regan	Alexandria, Va	Noble Smith	The Gums	3	17.74
	Total				78	457.70

Number of shad sold in Alexandria, season of 1886 34,847
Number of herring sold in Alexandria, season of 1886 3,979,324

WHERE ROCKFISH BREED.—Mr. William N. Habersham, writing from Savannah, Ga., on April 8, 1886, says: "The rockfish breed here during the spring at the heads of all our rivers. The young, 2 or 3 inches long, are caught in nets while casting for shrimps and hard-backs. In the interior, at a place where the road crosses the head-waters of a shallow stream emptying into the Ogeechee River, after a rainfall I have seen rock of 20, 30, and even 40 pounds wriggling their way through to a lagoon beyond, exposing parts of their bodies at times, and being beaten with sticks and clubbed while they were pushing their way over the road. During the summer I live near a small salt-water river—the Vernon—that empties into Ossabaw Sound, and the rock go up to its headwaters among the lagoons and swamps in the winter and spring, and their young are always found on the shores when casting for prawns."

In a later letter, dated May 22, 1886, Mr. Habersham adds: "The rockfish breed at least as far north as Canada, as in the Province of New Brunswick they abound on the North Shore from Shediac to Dalhousie, and are found in the Restigouche, Saint John, and Miramichi Rivers, where I knew them over thirty years ago. The young rock, from 4 to 6 inches long, are there taken in the smelt bag-nets, which taking is hastening their extermination. They spawn there in the rivers about the last of May, and run to sea after spawning, returning about September 1, and remaining in fresh water until after spawning again the following spring. They visit the harbor of Bathurst, on an arm of the Bay of Chaleurs, apparently in pursuit of the sand-launce, stopping only a few weeks, but not spawning there, as they prefer sluggish water. In addition to my own knowledge of the subject, what I have said about rockfish in Canada is confirmed by Mr. William H. Venning, inspector of fisheries in New Brunswick."

BILL TO PROTECT THE FREEDOM OF COMMERCIAL INTERCOURSE.*—*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That whenever the President shall be satisfied that American vessels are denied the privilege of purchasing supplies or bait, or any other commercial privilege, in any port or ports of any foreign country, he may, by proclamation, prohibit the vessels of such country, or of any designated district, port, colony, or dependency thereof, or any class of such vessels, from entering American ports, or from exercising such commercial privileges therein as he may in such proclamation define, for such period as he may prescribe; and on and after the date named in such proclamation for it to take effect, if the master, officer, or agent of any such vessel of such foreign country excluded by said proclamation from the exercise of any commercial privileges shall do any act prohibited by said proclamation, in the ports, harbors, or waters of the United States, for or on account of such vessel, such vessel and its rigging, tackle, furniture, and boats, and all the goods on board, shall be liable to seizure and to forfeiture to the United States; and any person opposing any officer of the United States in the enforcement of this act, or aiding and abetting any other person in such opposition, shall forfeit eight hundred dollars, and shall be guilty of a misdemeanor, and, upon conviction, shall be liable to imprisonment for a term not exceeding two years.

A VESSEL STRUCK FOUR TIMES BY A SWORDFISH.—Mr. W. A. Wilcox, writing from Gloucester, Mass., on August 7, 1886, says:

"The schooner Volunteer, of Gloucester, arrived on August 3 from a mackerel trip of several weeks in the neighborhood of Block Island. Capt. Robert Smith reports that on June 15 he was 2 miles west of Block Island at 4 p. m., when the vessel received a severe shock, much

* This bill (H. R. 9210) was introduced in the House of Representatives by Mr. R. T. Davis, of Massachusetts, on June 7, 1886, and referred to the Committee on Commerce. It was reported back July 17, and ordered to be printed.

as if it had struck upon a rock. At the time they were almost becalmed. On looking over the vessel's side a large swordfish was seen, which repeatedly struck the vessel with great force. A boat was quickly manned, and a harpoon soon finished the fish. On taking it on board it was found that the entire sword was gone, taking away the upper jaw and both eyes. The fish weighed 300 pounds.

"On arriving at Gloucester the Volunteer went on the marine railway, when the work of the swordfish was soon found. Six feet from the stem, near the top of the keel, within a space of 10 inches by 6, the sword had penetrated and broken off four times, even with the face of the keel, four pieces of the sword being deeply imbedded in the wood. The carpenters dug out one small piece, but the others are still imbedded in the keel. The distance between the centers of the two extreme holes is just 10 inches. That a swordfish should repeatedly run its broken sword into the keel of a vessel seems very strange, but such is the fact."

GROWTH OF CARP.—Mr. J. Luther Bowers, writing from Berryville, Va., August 13, 1886, states that he received from the U. S. Fish Commission some carp weighing about 1 ounce apiece, on March 25, last, and that on August 12 he caught six of them, which together weighed 10 pounds, being an average of $26\frac{2}{3}$ ounces to each fish. The time from being placed in the pond to being caught was one hundred and thirty-nine days, and as they averaged an increase of $25\frac{2}{3}$ ounces, each fish must have gained on the average 1 ounce in about five and one-half days. These carp on being eaten were found to be of excellent flavor.

SUCCESS WITH TROUT AND SALMON.—Dr. C. H. Barbour writes from Rutland, Vt., on September 15, 1886, saying: "The lake that I stocked with 800,000 trout and 20,000 landlocked salmon which I received from the U. S. Fish Commission, is a success. Salmon are taken there weighing $6\frac{3}{4}$ pounds."

GAFF-TOPSAIL CATFISH TAKEN IN NARRAGANSETT BAY.—Mr. George A. Lewis, writing from Wickford, R. I., August 31, 1886, says: "There have been thus far three gaff-topsail catfish caught near here this season. They were about 15 inches long, and agreed with the description and plate given in the quarto History of Aquatic Animals, by means of which they were identified."

POISONOUS EFFECTS OF SEWAGE ON FISH.—Messrs. C. Weigett, O. Saere, and L. Schwab have investigated the effects on fisheries and fish-culture of sewage and industrial waste waters, and find them very damaging. Chloride of lime, 0.04 to 0.005 per cent chlorine, exerted an immediately deadly action upon tench, while trout and salmon perished in the presence of 0.0008 per cent of chlorine. One per cent of hydrochloric acid kills tench and trout. Iron and alum act as specific poisons upon fishes. Solution of caustic lime has an exceedingly violent effect upon them. Sodium sulphide, 0.1 per cent was endured by tench for 30 minutes. [Popular Science Monthly, September, 1886, p. 719].

Vol. VI, No. 10. Washington, D. C. Aug. 25, 1886.

49.—ON THE FOOD AND DIGESTION OF GERMAN FISH.*

By Dr. P. PANCRITIUS.

At the request of the Fishery Association of East and West Prussia I commenced a series of anatomical and physiological observations of the alimentary canal and the digestion of our fish, which will not be finished for some time, but concerning which I am able to make a preliminary report. Any experiments in feeding made on the basis of my results, will of course have to be made only in suitably arranged ponds, as in the narrow tanks at my disposal the fish live under too unnatural conditions to draw definite conclusions as to the influence of food on the increase of size and weight.

The alimentary canal of fish begins in the mouth, which is more or less furnished with teeth, to which is joined a wide throat with folds running lengthwise. The throat leads into a cylindrical tube, sometimes straight, and sometimes more or less twisted, which opens at the anus. In the lampreys the entire alimentary canal is of an even, cylindrical form, and entirely straight; in some fish it is somewhat twisted, but no distinction can be recognized between the stomach and the intestinal canal; while in other fish the stomach may easily be recognized as bag-like or at least as a considerably widened portion of that canal. A microscopic examination of the mucous membrane, which lines the entire alimentary canal, shows that in a large group of fish, to which among the rest the carp belong, the stomach is wanting, so that the intestinal canal commences at the throat. It is a characteristic feature of the stomach of fish, as well as of warm-blooded animals, that its mucous membrane possesses pepsin glands. These glands secrete a ferment (pepsin) which, together with a free acid produced by the glands of the mucous membrane, digests albuminous matter, that is to say, dissolves it and makes it fit to be received in the organism of fish. The pepsin of fish is distinguished from that of the mammals by the circumstance that even at a temperature far below 15° C. [59° Fahr.] it possesses an intensely digestive power, which is considerably increased by raising the temperature to 40° [104° F.], while it is entirely destroyed if the temperature is lowered to zero [32° F.]. In fish which possess a stomach the mucous membrane of the entire intestinal canal connected with it shows no digestive faculties, but serves only to absorb the albuminous matter dissolved by the gastric juice. The gall secreted from

* "*Ueber Nahrung und Verdauung unserer Fische.*" From *Berichte des Fischerei-Vereins der Provinzen Ost- und Westpreussen*; 1885–'86, No. 2; Königsberg, October, 1885. Translated from the German by HERMAN JACOBSON.

the liver, however, goes into the intestinal canal, as well as does a juice secreted by the pancreas and the appendages of the cæcum. Both the pancreas and the appendages of the cæcum are wanting in many fish. The appendages referred to, which in varying number are attached to the front part of the intestinal canal (3 in the perch, 19 to 150 in the salmonoids, and upwards of 200 in the mackerel), are often connected into a glandular mass by a loose tissue.

The gall-bladder does not digest albuminous matter, but contains a so-called "diastatic" ferment which transforms soaked starch to sugar, and thus renders it fit to be received in the organism. The liquids secreted by the pancreas and the appendages of the cæcum react in a neutral or alkalic manner, digest albumen, and to a limited extent possess the faculty of transforming soaked starch to sugar. Like the gall-bladder they also possess the faculty of changing fatty substances to an emulsion, and thus preparing them for absorption by the intestinal canal.

Matters are very different in those fish which have no stomach, for instance, in the carp and bleak. Here the entire intestinal canal, from the throat to the anus (though to a much greater extent in the front than in the back part), secretes a liquid, which in its effect resembles that secreted by the pancreas, and which therefore digests both albuminous matter and soaked starch, as well as fatty substances. These fish have no appendages to the cæcum, but the liver pours a considerable quantity of gall into the intestinal canal, immediately back of the throat. These fish, therefore, are capable of digesting albuminous matter, carbohydrates, and fatty substances.

It is well known that fish do not masticate their food, as the teeth of predatory fish serve only to take hold of and to retain food. Even in those fish which possess strong teeth, worms and the larvæ of insects are only squeezed somewhat. Nor do fish envelop their food in saliva while in the mouth, as is done by mammals, as fish have no salivary glands.

Although the food, therefore, reaches the alimentary canal without any preparation favoring digestion, the alimentary canal in the majority of our fish is comparatively short. While in the cat, for instance, it is 3 times the length of the body, in man 6 times, in the horse 12 times, and in the goat even 26 times, we find that, according to numerous measurements, the proportion of the length of the body and the length of the alimentary canal is in the pike, hake, whiting, and tench, as 1 : 1; in the bass, perch, and eel it is as 3 : 2; in the crucian carp as 2 : 3; and in the *wels*, as 11 : 8. Only in a few species of fish does the length of the alimentary canal exceed that of the body to any great extent. A notable example is the lump-fish (*Cyclopterus lumpus*) of the Baltic, whose alimentary canal is from 6 to 10 times as long as the body.

The rapidity of digestion depends very much on the quantity of food taken at one time. Small quantities are, of course, digested quicker than large ones. If a pike swallows a fish half its own size, so that in

the beginning the tail protrudes from the mouth, the head is, of course, digested very soon; but gradually there is some delay, as the digestive liquids are only secreted in limited quantity, and the dissolved substances can be absorbed only gradually. Pike are not suitable for making observations relative to the time occupied by digestion, as they are in the habit of throwing up very soon some of the prey which they have swallowed; but I have made experiments with perch and hake which were fed on worms.

A number of perch, measuring each about 15 centimeters [about 6 inches] in length, which had been kept on very short rations for some time previous, were fed on worms, which they swallowed so greedily that their bag-like stomachs were filled to their utmost capacity. In a perch killed two hours later the food was found only in the stomach, the gastric juices reacting in a strongly acid manner. After eight or ten hours a portion of the worms had reached the front part of the intestinal canal; but even after twenty or twenty-four hours the stomach was still very full, while at the end of the intestinal canal balls of feces were already forming; after sixty or seventy hours the stomach was empty; and after one hundred and ten hours the front and middle parts of the intestinal canal had likewise become empty, and only at the end of the canal were there feces, and digestion might therefore be considered as finished.

In hake which had been well fed with worms, they evenly filled the entire intestinal canal from the throat to the anus after twelve or fifteen hours; but owing to the stronger secretion of gastric juice in the front part of the intestinal canal, they had been better digested there than in the lower part. This explains the observation that half-digested particles of food frequently protrude from the anus of fish, and from it the conclusion may be drawn that if fish are to be fed with the view to fatten them it is better to give them moderate quantities of food at frequent intervals, than to give them large quantities at longer intervals.

The carp-like fish are frequently termed herbivorous fish, in contradistinction to predaceous fish. This term, as I have been taught by numerous investigations, is entirely erroneous. While young fish of all kinds, examined by me, were found to have eaten small crustaceans and infusorians, the intestinal canal of all fish of the carp kind, measuring more than a finger's length, always contained at all seasons larvæ of gnats, dragon-flies, day-flies, beetles, &c.

Large quantities of plants (green algæ) I found regularly only in the intestinal canal of *Chondrostoma nasus;* but it remains to be examined whether the algæ or the large quantities of infusorians and other diminutive animals adhering to them, form the principal food of this fish.

Uncooked starch flour was not digested by any of the fish which I examined. Even when, after being stirred with water, it was injected into the intestinal canal and remained there for days, the extracts of

the digestive liquids produced in different ways did not in the slightest change it; but when it was boiled or roasted it was easily changed to sugar and thus rendered soluble. It is, therefore, evident that of the seeds of some grasses growing in the water and the young shoots of some aquatic plants, which are occasionally found in the intestinal canal of carp, and of the grains of wheat, &c., which I discovered in some fish, and which Professor Fric found in large quantities in the stomach of young salmon, it was not the starch which was digested, but the small quantity of albumen, fat, and sugar contained in them.

50.—POISONOUS FISH.*

By Dr. OSCAR TYBRING.

It is well known that in many places, especially in the tropics, there is a risk of eating fish which are injurious to health and which may even endanger life. Some fish seem to be poisonous at certain seasons of the year, while at others they are perfectly harmless. The spawning season seems to be the one in which they are particularly dangerous. Some fish are poisonous when caught in certain localities, while in others they may be eaten without any bad result. In most fish of this kind it is not the meat which is poisonous, but the entrails, especially the liver, the roe, and the milt; sometimes the skin also is poisonous; and finally there are some fish whose meat is poisonous. Certain kinds furnish a perfectly harmless food if eaten as soon as they are taken out of the water, but if they are allowed to lie only an hour their flesh spoils.

One cannot judge by the appearance of the fish, for those that look finest and most appetizing are frequently the ones that are poisonous; while there are fish which have a revolting appearance, but which are harmless and good to eat.

In the East Indian and Australian waters the poisonous *Meletta* is found in large numbers. It greatly resembles a herring, to which family it belongs; it is 5 or 6 inches long, with a sharp, serrated belly, silvery scales, and a bluish-green back. Foussagrive states as its principal characteristic that it has no teeth, with the exception of a few very small ones on the tongue. This fish is found especially near the Seychelles and near New Caledonia. It is always poisonous; and when eaten, causes vomiting, violent diarrhea, chills, a languid feeling, and invariably pain and cramps, particularly in the legs; the symptoms, therefore, resemble those of cholera. It is often caught with another kind of *Meletta* which is not strictly poisonous, and which may be distinguished from the poisonous one by having larger scales. The poisonous *Meletta* has a black snout and a black spot on the dorsal fin. Other-

* "*Giftige Fiske.*" From the *Norsk Fiskeritidende*, Bergen, October, 1885. Translated from the Danish by HERMAN JACOBSON.

wise these two kinds of fish cannot easily be distinguished one from the other. The second kind of *Meletta*, or the tropical herring (*Meletta thrissa*), is quite common on the coast of Brazil, in the West Indies, and on the east coast of North America as far north as New York. It is considered dangerous, especially during the spawning season, the roe being its most poisonous part. From San Domingo cases have been reported where people have died from eating this fish. Hornemann in his medical work says that it is advisable to forbid the crews to eat any fish of the sardine kind (to which family the *Melettas* belong) in the tropics, especially during the spawning season, an advice which should be heeded, as mistakes may easily have fatal consequences.

From Japan we also have reports of poisoning by fish of a similar kind, the *Engraulis japonica*. It is found in large numbers, especially near Nagasaki, and is most dangerous during the time from July to September. In the same locality the *Enorantis japonica* is also found, which Foussagrive supposes to be the same fish as *Meletta thrissa*.

In the Brazilian and West Indian waters the *Caranx fallax* (belonging to the mackerel family) is found. In Havana it is called "jurel." It may be distinguished from the *Caranx carangus*, which is common throughout the entire tropical portion of the Atlantic, by the following marks: The harmless *Caranx* has a black spot on the gill-covers, which is wanting in the poisonous one. The poisonous *Caranx* also grows larger, sometimes weighing as much as 25 pounds, while the other rarely weighs more than 2 pounds; for which reason it is prohibited in Havana to sell *Caranx* weighing more than 2 pounds. The poisonous *Caranx* has scales on the neck, while the other has a bare neck. The poisonous one has invariably twenty-two rays in the second dorsal fin. It is also said that this fish is poisonous only when worms are found in its head; this should, if true, also be considered as a distinguishing mark.

Another kind of mackerel (*Caranx plumieri*) is also found in the West Indies, and is poisonous only in certain localities and at certain times; but then it is poisonous to a high degree. In the French West India Islands it is called "coulirou," and the Spaniards call it "chiçaro." Hornemann states that in Havana it is not considered poisonous, but in Guadeloupe, where it is found in large quantities, and where it has a very fine flavor, it sometimes happens that specimens of this fish are caught which are so poisonous that they are used to poison rats. It is said that these poisonous specimens may be distinguished by the circumstance that their bones are red, which is not the case with the harmless ones. It very much resembles the common mackerel, but is shorter and thicker from belly to back.

The bonito also (*Scomber pelamys*), which belongs to the same family and which is frequently very delicious as an article of food, under certain circumstances may be, if not poisonous, at any rate unwholesome and hurtful. There have been instances where the eating of this fish has caused colic and diarrhea, and an itch breaking out on the skin. In

the Antilles the *Tynnus vulgaris* is also considered dangerous; and in the Mediterranean it is sometimes, but rarely, said to cause indigestion. The same is said also of *Cybium cavalla.*

In the West Indies the *Sphyræna becuna* is found. It has a long-stretched body (about 2 feet long), and a pointed head resembling that of the pike, and sharp, lancet-shaped teeth, some of the front ones, both in the upper and lower jaw, being larger than the others. It has two dorsal fins, with a large space between them. Its meat is usually wholesome; but sometimes, when it is presumed to have eaten poisonous fish, it becomes very hurtful. It is said that the fact of its being poisonous is shown by the teeth being black at the roots.

The *Sphyræna barracuda* is much larger than the *Sphyræna becuna*, and sometimes becomes 15 feet long. It is found on the coast of Brazil, in the Antilles, and the Bahamas; and is likewise poisonous at certain times. This is the case when the teeth are black, the liver tastes bitter, and a black juice oozes out of the flesh when it is cut. In the port of Rio Janeiro several men belonging to a French frigate were dangerously poisoned in 1862 by eating a fish which the natives called cação and which Royde Méricourt supposes to have been the *Sphyræna barracuda*. This fish also becomes dangerous by attacking people while bathing in the sea, and inflicting ugly wounds with its sharp teeth.

There is some uncertainty as regards the poisonous character of *Diodon attinga*, *D. histrix*, *D. tigrinus*, and *Tetrodon ocellatus*, *T. sccleratus*, and *T. maculatus;* but it may be laid down as a rule that they should not be eaten, as most of them are either poisonous or at any rate unwholesome. They may be recognized by not having any scales, but either large thick spines or short thin pins all over the body. Some of these fish can puff themselves up, and thus float on the water, belly upward. They have a tooth in each jaw, each tooth having a deep furrow running lengthwise, so that it looks as if there were two teeth by the side of each other. Some of these kinds of fish are found near Rio Janeiro, and are considered very dangerous.

Near the Cape of Good Hope (Simon's Bay), the *Tetrodon sccleratus* or *Gencion maculatum* is found, which is frequently very poisonous. It is also called "hoad-fish."

Among the *Scarus* family there are several which are poisonous. They are distinguished by their beautiful colors, and are very common in the tropics. Near Isle de France, in the Antilles, and also in China and Japan, several poisonous species of this fish are found. Hornemann states that in the Seychelles there are two kinds, one of which is poisonous, and may be recognized by having a deeply indented caudal fin, while that of the harmless kind is hardly indented at all. Near Isle de France the *Scarus vetula* is found; in the Antilles (Guadeloupe) the *Belone caribæa;* and in China and Japan a kind of *Lophius*, resembling the *Lophius setigera;* all of which are poisonous.

As regards sharks, which are also occasionally used as food, it may

be said that their meat has not a very fine flavor, and is sometimes very indigestible; otherwise it cannot be considered hurtful, and may therefore be eaten with moderation.

The *Murœna* is sometimes unwholesome when it is very large (more than 5 or 6 pounds), but it cannot strictly be termed poisonous.

In the Norwegian waters there are no poisonous fish, but it is well known that the sting-bull may be dangerous if one happens to run the pointed dorsal fin into the finger or any other part of the body. This fish is found also in the Mediterranean and in some places in the tropics; and seems to inflict more dangerous wounds there than in more northern waters, sometimes even causing death in a very short time. It is said in Norway that wounds produced by the fin of this fish may be cured by its liver; the same result, however, would undoubtedly be obtained if the wound was treated like any other poisonous wound.

There are several other kinds of fish which may cause dangerous or painful wounds by the spines of their fins or gill-covers, such as some of the varieties of the frog-fish, the sheat-fish, and the thorn-back.

It seems as if in all of the above-mentioned fish which are poisonous in themselves that it is the same kind of poison that produces this result in all of them; at least if we consider the symptoms following the eating of these fish, which are the same in all cases. They consist in diarrhea, vomiting, violent pain in the stomach, colic, and an exceedingly languid feeling, which may become as extreme as in cholera, and is often accompanied by cramps, stiffness, chills, and extreme weakness, leading to death. The symptoms, therefore, resemble those of the cholera. But nothing definite is thus far known as to the kind of poison which has this effect, why it has this effect, and what causes the variations of this effect.

This is certain, however, that there is every reason to exercise caution in places where poisonous fish are found. At the Cape of Good Hope every vessel which arrives is warned against poisonous fish. As regards the treatment of cases of poisoning by fish, it should be the main object to remove the poison from the stomach as quickly as possible by using emetics; and when weakness sets in, to use ether and alcoholics to keep up strength. Opiates may also be used in cases of pain in the stomach and cramps.

It would be very desirable if persons whose calling frequently takes them to the tropics would aid in extending our knowledge of poisonous fish by bringing home specimens put up in alcohol, or at any rate by noting the distinguishing marks of such fish and the places where they are found, and by obtaining information on these points from the natives. Information should also be sought regarding the symptoms of poisoning, and especially as to the mode of treatment; for it frequently happens that the natives of those countries where poisonous animals are found know the most effective remedies, which are entirely unknown in other places.

51.—THE HERRING FISHERIES NEAR THE ISLE OF MAN.*

By CARL SIMONSEN.

Near the Isle of Man, which lies in the Irish Sea, about 30 miles from the coasts of England and Ireland, considerable herring fisheries are carried on in July, August, and September. These fisheries are specially important on account of the quality of the herring which are caught in these waters, and the careful way in which they are cured. "Manx kippers" are, when smoked, an article much sought after in the English fish-markets.

Herring of the same kind are caught on the coast of Ireland as early as June; but later in the season they go into the Irish Sea and give rise to enormous fisheries, especially on the west coast of the Isle of Man. As regards quality, these herring exceed every kind of Scandinavian herring. In proportion to the size of the body, these herring have a small head, and are exceedingly fat and of a delicious flavor. Their length is about 10 or 11 inches. Some of them weigh three-quarters of a pound each.

The town of Peel, on the west coast of the island, may be said to have originated and been built up by the herring fisheries. When we take into consideration that the population of Peel is only 4,000, of which 2,000 serve on the fishing fleet, we see that the fisheries are very important to its population. Peel possesses about 250 large fishing smacks, with a total value of 2,000,000 crowns [$536,000]. As a general rule the captain has a share in the vessel, while the crew (usually seven or eight men) receive fixed wages and a certain percentage of the fish caught. The other shares are held by the fish-dealers in the Isle of Man or in England, and yield a good dividend. The town has two ship-yards, and two net-factories. The construction of the vessels differs somewhat from that of the Danish, principally by their sharp perpendicular bows, and by the circumstance that they draw 2 or 3 feet more water than the Danish vessels. Besides the fishing fleet belonging to Peel, there congregate here during the season, fishing vessels from Ireland, Scotland, and Cornwall, so that a fleet of more than 300 vessels is employed in these fisheries. I have several times gone out on one of these vessels, which usually leave the harbor some time in the afternoon and sail in a northwesterly direction to the fishing places, which are about from 7 to 10 miles out at sea; some vessels, however go still farther out. The nets are cast immediately after sundown, and in no case sooner.

The fishermen do not select any special point for casting their nets,

* "*Sildefisket ved Öen Man.*" From the Danish *Fiskeritidende*, Copenhagen, September 1, 1885. Translated from the Danish by HERMAN JACOBSON.

and no investigation is ever made to see whether there are herring in such a place or not. This will be seen in the morning. Each boat has from fifteen to twenty nets. Each net is 50 fathoms long, and the entire chain of nets extends for a considerable distance. The width of the meshes is 1 inch. The depth of the net is 45 feet; but its upper edge is, by the line leading to the floats, sunk 24 feet below the surface of the water. No sinkers are employed. Each net has five floats. As such the Manx fishermen generally use dog-skins or sheep-skins; and if these cannot be obtained in sufficient number, corks are used for alternate floats. A heavier line runs along the upper edge of the net, and the lines holding the floats are tied to it. After the net has been set, the vessel takes up a position near its end, having the top and the bottom line on board; and then the herring are at liberty to rush into the net as fast as they can. A watch is set on board, and the rest of the crew go to bed.

Each vessel has an engine for hauling in the net. At 2 a. m. the fire is started in this engine, and at the first break of dawn the fishermen begin to haul in the net with the fish. The heavy line running along the upper edge of the net, called "false back," is drawn in by the engine, and at the same time raises the net and drives the vessel forward along its side. It is a pretty sight when the herring, glittering in the rays of the morning sun, are drawn on board. If the catch is good, the net is hauled on board as fast as possible, and the herring are taken out later; but if only a few fish have been caught, the nets are immediately put in order for next morning's haul, the sails are set, and the homeward voyage is begun.

The quantity of fish caught, of course, varies greatly. Some vessels catch as much as 100 cubic feet in one night, while others, during the same time, catch only a few hundred fish. Fifty cubic feet is considered a good catch. When the fishing fleet returns to the harbor, about 6 or 7 a. m., everything is ready for the sale of the fish. The English firms which during the season do business on the island are all represented by their agents. The sale is by auction, the larger share-holders insisting on this mode of selling, which is the most satisfactory to all parties concerned.

A sample of the fish caught by one boat is shown, and the quantity is announced, whereupon the bidding commences. The fish are sold by the mease, a mease containing about five hundred fish. Each hundred has forty-two lots at three fish each, so that a hundred is in reality one hundred and twenty-six.

The price of the mease varies considerably, and depends of course on the catch made during the day, on the quality of the fish, and the condition of the market. The lowest price per mease during this season was 9 shillings, and the highest 30 shillings. The average price for a good article is about 20 shillings. Generally some salt is immediately sprinkled over the fish, especially during warm weather. In Peel itself

there is only one smoke-house, owned by the firm of Kelsall Brothers. The other smoke-houses are in Douglas, a town on the east coast of the island, whence there is daily communication with Liverpool by steamer. The herring are conveyed across the island by wagons. The Messrs. Kelsall employ in their smoke-house twenty-four girls and ten men. The girls all come from the eastern part of England, and generally find employment in the smoke-house all the year round. Their wages are 16 shillings per week.

After the herring have been cleaned, and have lain in brine for an hour, they are exposed to a strong smoke for about four hours, there being a constant current of air through the oven. After having undergone this treatment, they are prepared as "kippers," for those markets which the Isle of Man principally supplies, namely, Liverpool and Manchester. The reason why the exportation of fish is limited to the north of England is this, that only firms from that part are represented on the island, and that these markets buy up all that the smoke-houses can produce. It may be stated here that "kippers" intended for markets in the south of England, especially London, must be smoked more strongly and have a higher color than is liked in the middle counties. The north of England, especially Liverpool and Manchester, prefer "kippers" of a light color, such as four hours' smoking will produce.

"Kippers" are of course cooked before they are eaten, and are then very delicious. After the fish have undergone the smoking process and have cooled off, they are packed in small boxes, 5 dozen in each, the belly downward. When the fish are of fine quality, such a box weighs about 17 pounds. The lid of the box is stamped with the coat of arms of the Isle of Man, and this stamp is a sufficient recommendation. If the buyer desires a good quality of fish, he buys Manx "kippers," although they are always higher priced than any other fish. He does not open the box, as is always done with Scotch "kippers." The stamp on the lid of the box is a sufficient guarantee for the good quality of the article. The price of Manx "kippers" varies between 5 and 6 shillings a box, while Scotch "kippers," only when there is a lack of Manx "kippers," will bring 4½ or 5 shillings a box. The Kelsall Brothers during the last month cured on an average 80 mease per day, that is, about 800 boxes, or 42,000 herring per day. But this is by no means the largest number of fish which this firm can turn out, as they possess seven ovens; and to produce the above-mentioned quantity they employ only three. The cause of this small production is this, that they do not sell a single box on commission, but regulate their production entirely by what their wholesale houses can sell in the Liverpool and Manchester markets. "Kippers" all through the season (which begins in spring near the coast of Scotland, and ends in December near Yarmouth on the east coast of England) are the principal smoked fish in the English fish-markets. These fish, which form a favorite article of food

in nearly every English household, have an exceedingly fine flavor, and cause an agreeable break in the monotony of the English table with its many meats. In Denmark there are hardly any smoke-houses which treat herring as "kippers" on the English plan. But it is certain that this method will soon be introduced, and doubtless with good results.

52.—CRAB FISHERIES PROPOSED IN DENMARK.*

Crabs are very common in the Cattegat, and still more so in the North Sea. One cannot pass a place on the shore where lobster fisheries are carried on without seeing the broken shells and claws of large crabs. But it is a rare occurrence for a fisherman to take any of these crabs home and cook and eat them. One very rarely sees crabs offered for sale in Denmark; and it is a very unusual occurrence to see any one eat such an "ugly" animal.

This is to be regretted, because crabs have a fine flavor, and contain, comparatively speaking, a good deal of food, if one only understands how to get at it, which is not very difficult. All that is needed is to remove the shell and take out all the soft parts and all the meat, all of which can be eaten, and which, in order to form a savory dish, needs only the same condiments as are used for lobsters. The claws also contain good meat; and on the whole it must be said that the crab is a better and more easily digested article of food than the lobster. It contains much more food-matter than is generally thought; and a good-sized crab almost fills a plate. It can therefore be imagined what a crab contains which, as is frequently the case, weighs several pounds. As a general rule it may be said that a crab which measures 4 inches across the back contains one-fourth of a pound of meat.

It is to be regretted that crabs do not yield any income to our fishermen, for the simple reason that they find no sale for them. There are plenty of crabs, a great many more than the fishermen care for; and as a general rule the lobster fishers catch ten crabs to every lobster. When the lobster-ring or lobster-pot is taken out of the water, and the fishermen find that crabs, which are worthless to him, take up the room and have eaten up the bait, he gets angry, and frequently gives vent to his feelings by crushing the crabs against the side of the boat. This would be different if crabs were of profit to the fishermen; but it must be remembered that it is not the fishermen alone who cling to old customs and prejudices. The crab is never mentioned on any Danish bill-of-fare, and there is, therefore, no demand for them, and crab fisheries are consequently not carried on.

All this would be different, if crabs could be exported. We think that

---

* "*Taskekrabben.*" From the Danish *Fiskeritidende*, Copenhagen, September 22, 1885. Translated from the Danish by HERMAN JACOBSON.

this is possible, if a proper method of transporting them could be found. It is maintained, but whether justly or not we do not know, that out of the water the crab cannot be kept alive as long as the lobster. If this should be the case, it is probable that some other method of transporting crabs could be found; if not raw, they could possibly be transported cooked.

Our hope in seeing our crabs made an article of commerce is based on the fact that crabs bring a high price in England. In London large quantities of crabs are offered for sale, and they may be seen in many stalls on the Strand, Fleet street, &c., where lobster salad and crab salad are favorite dishes. In the London markets last summer [1885] the price of crabs varied from 8 cents to 90 cents apiece, while the average price was about 40 cents. Such figures ought to furnish a satisfactory answer to the question, whether our crabs are too good an article to be left lying on the sea-shore, all the more as our fishermen incidentally catch ten times more crabs than lobsters, which represent a considerable income in our fisheries.

There is therefore every reason to urge our fish-dealers to take up this matter. Attempts should be made to export crabs. Even if they were to bring a much lower price than is paid for them in the London fish-market, these fisheries would yield some profit; and we are convinced that our fishermen would be well satisfied, if they could sell crabs at a low price. But our fish-dealers should also endeavor to introduce crabs in our domestic fish-markets. The Danish public might possibly be induced to entertain a better idea of crabs, if it learns what prices are paid for them in London.

53.—CARP CULTURE IN SWEDEN.*

By FILIP TRYBOM.

Carp culture has of late years made considerable progress in Sweden, after the old carp ponds had been allowed to lie idle for a long time, as is unfortunately still the case in many parts of Denmark. Carp culture was again taken up in 1879, when C. Wendt, a landed proprietor, who was familiar with it from his German home, commenced carp culture on a large scale and according to a rational method, on his property Gustafsberg, near Perstorp. His land comprises several small lakes, which are very well adapted to carp culture, as they can be laid entirely dry and again be filled with water. The gentle valleys on his property have mostly an otherwise worthless peat and swamp soil, where, by means of dikes, ponds can easily be formed. These ponds are amply supplied with water from marshes lying on higher ground, at least under the usual conditions of rain.

* "*Om Karpearl i Sverige.*" From the Danish *Fiskeritidende*, Copenhagen, September 29, 1885. Translated from the Danish by HERMAN JACOBSON.

The first year he used about 12 acres of land [4 *tönder;* and 1 *tönde*= about 3 acres] for carp ponds. From sixteen female and ten male carp, which he obtained from Denmark, he raised one hundred thousand carp, sufficient to stock an area of about 1,200 acres. In the north of Germany, Denmark, and the south of Sweden, carp are ready to spawn in the third or fourth year, and weigh at that time from 2 to 4 pounds. Each female contains about one hundred thousand eggs, but of course not all of these become young fish.

The ponds for the young fry are not made very large, about from 1 acre to a few acres in extent. They should have very flat banks, and have shallow water throughout, from 1 to a few feet deep; if the water is deeper it is heated too slowly, the carp spawn too late in the season, the eggs are hatched very slowly, and the development of the young fish does not progress fast enough. The fish do not only become thinner and more slender during the first summer, but even later their growth will be retarded. In Germany the opinion is held that carp do not like to spawn until the water has a temperature of 17.5° C. [about 63° F.], and some people even maintain that the temperature of the water should be from 22.5° to 25° C. [about 75° F.].

Near Gustafsberg the spawning season has often set in during the last half of May, and the young carp have been hatched in as short a time as six days; but when the weather was cold it has taken ten or more days. A warm spring and a mild autumn are of the greatest importance for carp culture. Mr. Wendt states that carp do not grow at all when the temperature of the water falls below 9° C. [about 48° F.], while their growth progresses in proportion as the warmth increases. The period of growth is, even in Germany, limited to five months, and it has been calculated that in May it is 13 per cent of the growth of the entire summer, in June 31 per cent, in July 34, in August 18, and in September 4 per cent. If the spring is warm, the growth is not only comparatively greater in May, but also greater throughout the entire year, as the young fry can then during the summer far better derive all the possible benefit from their food. Attempts have therefore been made in Germany, and with considerable success, to cause carp to spawn earlier than usual by heating the water, so that they spawn as early as March. One spring Mr. Wendt placed glass frames over a portion of his pond which contained young fry, but this experiment was not successful.

The ponds for the young fry (as it is advisable to have several of them), as well as the ponds for the growing fish, should be kept dry previous to the time when carp are to be placed in them. This method has several advantages. Thus, the water gets warm sooner in a pond which has lain dry. Von dem Borne observed that while the temperature in such ponds was, in the middle of May, 20° C. [68° F.], it was in others where the water had stood for some time, only 17.5° C. [63° F.]. The consequence was a full month's difference in the spawning time, and moreover the young fry in the first-mentioned ponds were much more

numerous. These ponds produce a much larger quantity of small crustaceans, which are the favorite food of young carp. If the ponds lie dry for some time, a large number of injurious insects and other animals which eat roe and young fish are destroyed.

In an area of about 18 acres, one hundred thousand young fish are placed. After about four weeks they are again placed in suitable ponds, each 3 acres receiving about five hundred and twenty-five fish, and when late in autumn the young fish are caught for the third time, about 70 or 72 per cent of them are left, weighing one-quarter of a pound and more apiece. If at the first transfer only from one hundred and fifty to two hundred and fifty carp per *tönde* are placed in the water (as is done in Austrian Silesia), the carp will weigh about a pound apiece at the end of the first summer.

At Gustafsberg the young carp (one year old) have of late years been transferred once during the summer, namely, in July. All the ponds have ditches or furrows, which meet in a large hole inside the dike, near its lower part, so that the fish may congregate there and can easily be caught when the water is let off. From 75 to 95 per cent of the transferred fish could be caught in autumn, if care was taken to protect the fish against their enemies. In 1882 Mr. Wendt set out two hundred and fifty one year's fish per 3 acres. In the autumn of the second year these fish had an average weight of nearly a pound, while some weighed 1½ pounds apiece; of fish that were a year older he set out one hundred, and of those that were still a year older (which were in their fourth summer), he put out from forty-eight to seventy-five in an area of 3 acres. It takes, however, the experience of many years to decide how many fish of the different ages must be placed in ponds of a certain character and size. Above everything else regard must be had to the nature of the bottom and the water. A barren bottom, where plants and small animals cannot live, is just as little adapted to a carp pond as cold spring-water. As a general rule several small ponds can support more fish than one large pond of the same extent, for in the smaller ponds the fish get a larger amount of shallow and warmer water. Formerly several times more fish were placed in the ponds than is done now. The result as regards weight was the same; but the economical advantage was less than now, because a small number of large fish will fetch a higher price than several small fish having the same combined weight.

Under the conditions referred to above, the fish in Mr. Wendt's ponds reach a weight of 2½ to 4 pounds during the fourth autumn, some fish occasionally reaching a weight of 5 or 6 pounds. In a less favorable year when many carp of the above-mentioned age have not reached a weight of 2½ pounds, they are set out in the ponds anew, so as to have another summer for growing. As a general rule, however, the fourth year is the one during which the Gustafsberg carp become salable. In Prussian Silesia carp reach a weight of 2 to 4 pounds when two and one-

half years old. The ponds are distributed in the following manner: From 12 to 15 acres are assigned to the young fry; 12 to 15 per cent of their entire water-area contains one-year-old carp; 18 to 25 per cent two-year-old carp; and in the remaining portion the three-year-old fish are kept, and in some years a few four-year-old fish, that is, those which had not yet reached the necessary size when three and one-half years old. A certain water area is set aside for wintering fish; and the ponds used for this purpose should be 7 feet deep, and if possible should be traversed by some running water containing air. Spring-water is well adapted to these ponds, because it does not freeze in winter.

The salable carp are, at Gustafsberg, placed in good-sized boxes with slat sides, which are set in a brook with a rapid current and clear water. Thus the fish can easily be got at when they are to be sold. In the brook-water they also very soon lose the peat or mud taste which they have when taken out of the ponds.

Late in autumn, in winter, and early in spring, carp do not, as a general rule, eat anything, nor do they grow.

Mr. Wendt has, at present, sixty-four carp ponds, covering an area of about 2,700 acres. The largest are lakes which have been laid dry. The average expense per annum is about 60 crowns [$16.08] per 3 acres, and sometimes it is even a little higher.

During the last two years from 30,000 to 45,000 pounds of carp have been sold from Gustafsberg. Some of them are sent to Stockholm and Copenhagen, where they bring 75 *öre* [20 cents] per pound. But the principal market for these carp is Lubeck, Germany, where 60 to 67 *öre* [about 16 cents] is paid per pound. The cost of transporting carp from Gustafsberg to Stockholm is about 8 *öre*, and to Lubeck 5 *öre* per pound, if the carp are shipped alive in casks filled with water. Supposing that the price of carp at Gustafsberg was 50 *öre* [13.8 cents] per pound, these carp ponds have nevertheless yielded an income of 15,000 to 22,500 crowns [$4,020 to $6,030] in two years, or a gross revenue of from 20 to 30 crowns [$5.36 to $8.04] per 3 acres. Mr. Wendt calculates that there is on an average an increase of 100 pounds per year, for every 3 acres. If all the ponds were filled with water every year and if this calculation remains correct, the gross receipts would be much higher. In Holstein people count on a net income of 27 crowns [$7.13] per 3 acres from carp ponds. For most of the carp ponds near Reinfeld, in Holstein, 85 crowns [$22.78] were paid per 3 acres during the years 1874 to 1884, when the price of carp was very high; but these ponds are particularly fine and very productive. For the large ponds near Peitz, in Lusatia (9,000 acres in extent), a rent of 48,000 crowns [$12,864] per annum was paid; that is, 16 crowns [$4.28] per 3 acres—the gross receipts from which were 43.20 crowns [$11.57] per 3 acres.

It is not easy to make any calculations as to the exact profit which will be derived from carp ponds; since, as in farming, there are years of failure and disappointed hopes.

During the pond fisheries early in November Mr. Wendt sold one-year-old fish at 10 crowns [$2.68] per hundred. Some of these fish were bought by persons from the provinces of Wermland, Vestergottland, &c. Whether carp culture north of Scania will pay, is a question which cannot as yet be answered. In such provinces as Småland and Wermland the growth would probably be too slow. It is quite probable that in a more northerly latitude than Scania the carp would gradually degenerate and become smaller. On a large scale it will hardly pay north of Scania, but experiments on a small scale may be recommended. Farther inland, where there is still a considerable supply of other fresh-water fish, the price of carp could not for any length of time be kept at the height of the German prices, and the transportation would cost more than from Scania. Locations should be chosen where the cost of construction is small, and which otherwise are of little or no value. In many respects it would be desirable that north of Scania attempts should be made to cultivate carp on a small scale, in ponds the construction of which would involve but little expense, and where the carp could either be used for home consumption or find a ready sale. In Germany much has recently been said and written in favor of planting large masses of young carp in peat-bogs, marl-pits, lakes, and rivers with a slow current, in the brackish water near the mouths of rivers, and in sheltered inlets of the sea. Experiments made in Berlin by Dr. Petri, at public expense, have shown that the saltness of the water in an aquarium, where carp, tench, goldfish, and eels were kept, could gradually be increased to 2¼ per cent without injurious influence on these fish, which remained in this water for more than half a year.

In Sweden the carp is said to have been introduced in 1560, and has since that time been cultivated on many farms in Scania. Linné states in his *Skånska Resa* (Journey through Scania) that in 1749 there were near Marsvinsholm 40 carp ponds, and that these were the largest and most important in the Kingdom. Formerly their number was much larger. It is hardly to be supposed that these ponds were as large as those at the present time in Germany or in Scania, nor is it probable that carp culture in the Scanian ponds was carried on then as rationally as it is now. In some ponds crucians were kept, and in others carp; in the ponds near Larkesholm—at least in one of them—the carp were allowed to stay from four to five years.

Linné does not state that these fish were kept in separate ponds; and it is therefore possible that this was not the custom when he visited Scania. But in a pamphlet on carp culture, published at Lund in 1766, O. Cederlof says that "care should be taken not to have the two kinds of fish intermingle." It was even then known that hybrids of carps are not of much value. Cederlof, who certainly got his information from Scanian carp cultivators, says in another place that "a pond having an area of 14 square yards would annually feed at least 300 three-year-old carp, 300 two-year-old carp, and 400 one-year-old carp."

STOCKHOLM, SWEDEN, *January* 19, 1885.

Vol. VI, No. 11. Washington, D. C. Aug. 25, 1886.

54.—THE ICELAND FRESH-WATER FISHERIES.*

In order to get a clearer idea of the hydrographic conditions of Iceland, it was my intention to make a trip to the Isholl Lake, whose natural conditions are said to be very peculiar. But when I learned that there was no boat on this lake, and that it is very limited in extent, I gave up this plan. At present no fisheries are carried on in this lake, for the simple reason that the inhabitants of that neighborhood have no inclination to fish. People prefer to get fresh fish from the Ofiord, which, when received there, are not in a very good condition, and which of course are not improved by being carried on horseback for a considerable distance. There are in the Isholl Lake both trout, and mountain-trout, which are said to be very good. This lake is very deep, being said to reach a depth of 30 fathoms in some places.

On August 8 I made an excursion to Hjaltöre, in order to witness the herring fisheries which were reported to have begun at that place. Upon arriving at Hjaltöre I learned that no herring had as yet been caught. I therefore crossed the fiord to visit Einar Asmundson, a member of the Iceland Assembly, at Nes. In his company I visited Sira Magnus at Laufos, and there examined some so-called *sjöreidur* which had been caught in the falls of the Fnjoská, near the place where it flows into the Ofiord. These fish were simply *birting*, that is to say, nothing but mountain-trout, which had entered the fresh water from the sea. Strange to say, no trout are caught in the falls. This is probably caused by the circumstance that the Fnjoská is not well adapted to these fish, as it is full of rocks; and nowhere could I discover suitable localities for spawning. The Fnjoská has very little vegetation. I have seen mountain-trout leap the falls just as rapidly as trout.

On August 11 I continued my journey, following the course of the Helgá, in which salmon are sometimes said to ascend. Higher up this river I found trout in great abundance. Everywhere there is the greatest quantity of fish-food.

I examined Lake Hraunsvatn as well as could be done during my short stay. It is said to be very deep; but several soundings which I took did not show a greater depth than 32 fathoms. At a depth of 23 fathoms the water had a temperature of 5° Celsius, while at the surface the temperature was 9°. The bottom has everywhere a grayish appearance, being a dark clay bottom, as in the Ljosavatn Lake. In this

* From the Danish *Fiskeritidende* for July 21 and 28 and August 4 and 18, 1885. Translated by HERMAN JACOBSON. For an article on the same subject, see F. C. Report for 1884, p. 323.

lake the mountain-trout are said to reach a weight of 8 pounds. I caught only one young fish, of a silver white color. But at the mouth of a little stream flowing into the lake I caught quite a number of fish, all of a dark color and very different in shape from fish caught in the lake.

In Lake Heradsvatn there are trout and mountain-trout; the latter are caught in nets, while the trout are caught only occasionally. Unfortunately the rain and fog prevented me from getting a good view of this lake. The Nordrá River is very rocky and has a clean bottom.

At Silfrastadir the river flows through a narrow valley, one rock rising above the other. Here and there there are small even places, and occasionally there is a small island in the river; and in some places there were large and deep holes in the rock filled with water. In some of the largest of these holes I found young fry which had been hatched this year, and also some young fish, probably hatched in 1883. Some of the sandy places in the bed of the river, which during the spawning season are under water, probably serve as spawning places. The water has a milky appearance, and the bottom, as everywhere in this neighborhood, seems to be stony.

On account of the rain I could not examine the river Svartá, which, however, does not offer any peculiar features to the observer.

At Bolstaderhlid I caught ten fish, all trout, weighing about 3 pounds each. These fish had a great many spots. They were lean, and seemed to be exceedingly voracious. Their stomachs were filled to repletion with dark vegetable matter (seeds, stems, old leaves, &c.), which probably had been swallowed, so that nothing which the current carried with it should escape a trial at digestion by these fish; an evident indication that these fish have a hard struggle for existence. I also found in the stomach and the intestinal canal, beetles, spiders, larvæ of a two-winged insect, and in one the remnants of a young trout. There are very few plants in the bed of this river, and none at all along its banks.

After having passed the Svartá and the Blandá, which near the ferry is said to contain no fish, I reached the farm Solheimar on Lake Svinavatn where I remained from August 16 to 18 waiting for better weather. This lake contains trout reaching the weight of 10 pounds. In Lake Svinavatn the *Gasterosteus pungitius* is said to be the principal food of the trout; and in the stomach of the one which I examined I found also remnants of this fish. Fishing is carried on with nets, and with lines with English steel hooks, and pieces of fish for bait. The nets are 12 fathoms long and 1 fathom deep; they are lowered by means of a stone partly sewed up in a piece of cloth. One farmer may catch from two to three thousand during the summer season, which are eaten either fresh or salted. In Lake Svinavatn the trout is of a better quality than the mountain-trout.

The river Laxá, which also receives water from Lake Svinavatn, flows

through the southern part of Lake Laxárvatn. The salmon ascend into the Laxárvatn only far enough to reach the portion of the stream between Lake Svinavatn and Lake Laxárvatn. No salmon are ever said to have been caught and no one had ever noticed that salmon spawned in the Laxárvatn, while they spawn in the stream between the two lakes and in the part of the Laxá River above the falls, below which the principal fisheries are at present carried on. The Laxárvatn has a rich vegetation, and is said also to contain a great many fish. I could not obtain any further information, and there was no boat on this lake. In 1884 but few salmon had been caught; the fish are rather small, and the river cannot be called a particularly good salmon river. There are but few spawning places, and the quantity of the water is not very great; especially below the falls there are large places where the water is very shallow, and there are but few holes. It is exceedingly easy to control the course of the fish and to catch them. On the other hand this river is very rich in fresh-water algæ, and therefore probably furnishes a good deal of food for young salmon. I could not, however, discover any young fish of the salmon kind. I caught several trout weighing about 3 pounds apiece, which were in excellent condition.

On my way to Blónduos I again visited the river Blandá. At present the salmon fisheries in this river are not very extensive, and but few were caught in 1884. Salmon-trout and mountain-trout are caught with nets and lines; near Blónduos fish-pots might be used to advantage.

As the weather became a little more favorable, on August 20 I visited the falls near the mouth of the river Blandá, where most fish are caught. I met the owner of these fisheries, Svenn Christoffersen. He and his father have carried on these fisheries since 1854. As in 1884, there have been periods (as from 1867 to 1869) when hardly any fish were caught.

Nine years ago, however, there were good fisheries, and about two hundred salmon were caught. During that same period a farmer living higher up the river also made good hauls, but at present he catches scarcely any fish. Since 1875 the salmon fisheries have not amounted to anything. Mr. Christoffersen could not tell me in what part of the Blandá the salmon spawn, and no one seems to know anything about it. The largest salmon are generally caught late in summer when the roe-bag is far from being full.

Owing to the decline of the fisheries, Mr. Christoffersen has greatly limited the number of his apparatus. He thinks that the decrease of the number of salmon is caused by the extensive digging for peat which has been carried on of late years; and that the refuse from the trading station and the noise which frequently prevails there has scared the salmon away. The severe winters from 1857 to 1865 have probably more to do with it. In 1880 the river Laxá froze down to the bottom, and the farmer living at Södarnes found many dead fish in the river. I have also made a note of the following statement: When Mr. Christoffersen was

a young man there were only two seals in the river, while now their number is considerable.

Near Hunaos I noticed near the sea about forty seals, while many more could be seen in the lake. The seals are caught with stationary nets, about 16 fathoms long and having meshes 6 inches wide. The seal fisheries begin towards the end of June, and last till the young seals leave their mothers. Shooting is not allowed here. On an average sixty seals are caught per annum, and the net income from this source is about 100 crowns [$26.80].

From Hnaussar, near the river Vatusdalsá, I went to the river Kornsá. On my way I visited, by the advice of the Rev. Torvald Asgeirsson, who very kindly accompanied me, several places along this river. In many places there have been landslides along the banks. Near one of these an English amateur fisherman a short time ago caught with a fly a male salmon weighing 31 pounds, probably a fish left over from the preceding year. In 1871 salmon were caught to the value of 800 crowns [$214.40], but as a general rule the annual income from the salmon fisheries is from 300 to 400 crowns [$80.40 to $107.20]. At the present time these fisheries are not very remunerative. In 1883 twelve salmon were caught, and in 1884 only one. The lake in the valley is being drained, and meadows are being formed. The entire valley seems to have undergone a complete change at a comparatively recent time, and this change has possibly also caused the decrease in the number of salmon.

After having witnessed the hauling in of the nets in the Vididalsá River, where (especially near Borg) a good many salmon are caught, I staid for awhile at Vididalstunga. Some of the fish which I saw here were young fish in excellent condition. Two male salmon were also caught; the milt was large, but not loose. Here twenty salmon weighing from 8 to 17 pounds were caught in 1884; and at Bordeyri 50 *öre* [13½ cents] a pound were paid for them. Most of these salmon are caught near the mouth of the Fitjá River, below the falls, which the salmon can leap.

Following the course of the river from Vididalstunga, the Kolugil Falls were reached. These are very high, and cannot be passed by the salmon. Occasionally a few salmon and trout are found below the Kolugil Falls; and I succeeded in catching several of them, all of which seemed half starved, nothing being found in their stomachs but a few beetles. I could not discover any young fish. Both rivers form excellent spawning places near Vididalstunga; but no one seems ever to have observed spawning salmon. Páll Pállson Dæli, however, states that the spawning season is late in September and October.

Four years ago, from three hundred to four hundred salmon were caught per annum. It is supposed that the seals congregating near the place where the river flows into the sea have caused this decrease. Every now and then the salmon ascend the river before the 20th of

May, but it often happens that the best hauls are made after the 15th of August.

It is impossible to construct a salmon-way over the Kolugil Falls. A little below the falls a salmon-trap has been placed in one of the branches of the river, but no fish have been caught in it. The salmon follow the main stream, but according to the law no trap can be placed in this. There are, however, only two persons who own these fisheries up to the falls; and as they agree perfectly, this limitation of the law seems very unnecessary.

At Melstadir, which I reached on August 24, and where I met a number of people from the neighborhood, everybody seemed convinced that the seals are the principal obstacle in the way of the salmon fisheries.

In the river Vestrá the salmon can go up as high as Rjukandi; in the Nupsá River they can go only as far as Efrinupr, and in the river Austrá they keep below the Kamb Falls. In 1884 hardly any salmon were caught in this river. On the whole, the natural conditions were very much the same as in the Vididalsá.

The Hrutafjardará three years ago yielded three hundred salmon a year. In 1884 not a single salmon was caught, and in the year previous only two. This river is not well adapted to the salmon, as they can ascend it only about 1 mile from the fiord, when the Rjettar Falls stop their progress. The mouth of the river becomes more and more obstructed by sand from year to year. There are probably not many good spawning places, and the river is easily exhausted.

The Nordrá, which flows into the Hvitá, has no salmon till a short distance below Hvammer, and even here only a few are caught. It is said that it is difficult for the salmon to pass the falls. I think, however, that the salmon might find very good spawning places in the greater portion of the Nordrá, at least up to the nearest falls, below Veidilækia, where at times the salmon fisheries in the deep places are very productive.

In the Hvitá the salmon go only as far as the Kláffos Falls. A large number go into the Tverá and its tributary, the Kjará. The Tverá is a much larger river than one is led to expect by looking at it on the map. Salmon also go into all the tributaries of the Hvitá and into the Borgarfiord. Among these tributaries containing salmon we may mention the Reikiadalsá, Flokadalsá, Grimsá, Andakilsá, Glufiá, Gufá, and Langá; but the salmon in the last-mentioned stream are small. In the Alftá, north of the Borgarfiord, there are very few salmon. Gudmundur Pálsson informed me that the Hitá is very rich in salmon; and that a good many are also caught in the Kaldá, Haffjardará, and Laxá. Some of these streams are very small, and have hardly any water; but it is probable that they would form an excellent field for observations of the salmon and the salmon fisheries. The salmon do not ascend the Hvitá

till May, and continue in this river till the end of August. Some people, however, informed me that they ascend still earlier in the season. I could not obtain any definite information as regards the spawning. It appears to me that the Icelanders have not paid much attention to the conditions of life of the salmon, which are of great importance as regards any measures for protecting the salmon and promoting the fisheries. The seals ascend the Hvitá as far as Kláffos, and have young ones there, several of which I noticed. In my judgment these falls are not an insurmountable obstacle in the way of the ascent of the salmon, but none have ever been caught above the falls; in fact, I believe no one has ever attempted to fish here. Possibly the river above the falls is too cold to afford proper spawning places.

Near Stafholtseyri and still farther up the Hvitá but few salmon were caught in 1884, nor have many been caught in the tributaries of that river. Thus, one farmer in the neighborhood caught only six in the Reikiadalsá. One salmon was caught as late as the 29th of August.

Near Nordtunga very considerable salmon fisheries are carried on. It seems that the spawning places begin here, and that the wealth of salmon in the Tverá originates here and in the Kjará. In the last-mentioned river large salmon fisheries are carried on, especially from Gilsbakka, whose inhabitants travel several days' journeys to the fishing places on the Kjará. Near Nordtunga salmon are caught early in May. In 1884 the first salmon was caught May 20. The owner of the Nordtunga farm maintained that those fish which ascend the river in May had already gone down the stream at the time of my visit (August 30). He thinks that the salmon which are found in the river in August probably spawn in October, but he has never noticed any salmon spawning. It is evident that there are spawning places near Nordtunga, and in the heaps of sand which are now lying dry we see probably former hidingplaces for salmon eggs.

Fishing is carried on with nets about 8 fathoms long and 1 fathom deep, and, like all nets used in this neighborhood, they are of exceedingly simple construction. These nets cannot carry enough, and do not follow the bottom as they should do. According to the statement of the farmer, the following number of salmon were caught during the last ten years: 1875, 300; 1876, 400; 1877, 500; 1878, 100; 1879, 30; 1880, 200; 1881, 2; 1882, 30; 1883, 14; 1884, 150.

On August 31 I rode up the Kjará River, accompanied by my guide, and took observations along the course of this stream. Near Ornolfstadir the bed of the river becomes rocky, and there are many small falls and deep holes. But it was my impression that as far as I rode (some distance beyond the Ulve Falls) there are no better spawning places than farther down near Nordtunga. I made vain attempts in different places to catch fish with flies or artificial fish, and nowhere could I discover the slightest trace of fish. My guide had no time to take me to

the upper fishing places, because every man was needed in the hay harvest.

Near Hvitávellir there are considerable salmon fisheries, which are carried on in a rational manner by the owner, Mr. Fjeldsted, who, more than most of the Icelanders who possess salmon fisheries, has given some attention to the matter. According to his idea, the salmon enter the mouth of the Hvitá as early as April. In 1884 the small salmon came first, while generally the larger ones are the first; last year the large salmon did not enter the river till July, while generally they come in May. Mr. Fjeldsted catches the largest salmon in the Grimsá, weighing on an average 30 pounds apiece. Mr. Fjeldsted has seen salmon near his farm as early as August and September. On September 6, 1882, he found salmon eggs in the Hvitá, and September 9 he found salmon eggs in the stomach of a *silungur*, which, therefore, must have eaten of eggs which had been freshly laid. In 1878 he found eggs in the spawning places on the 20th and 29th of August. During severe winters Mr. Fjeldsted has seen masses of salmon eggs, frozen together, carried away by the current underneath the ice. According to his idea, the young salmon had already left the river and gone to the sea, so that I would have no chance to see any; and true enough, in spite of all my efforts, I could not discover any. Mr. Fjeldsted has given me some general idea of his fisheries during the last seven years, and termed them, in 1878, tolerably good; 1879, poor; 1880, poor; 1881, very poor; 1882, very poor; 1883, good; and 1884, very good (900 fish).

Farther up the Hvitá and in the Tverá they use besides seines also small nets, which are set from the shore or from a little stone dam, and which are kept extended by the current. The fish going along the banks stick fast in the meshes. Most of the fish, however, which are caught in these small nets are trout. These nets are probably the model for the so-called *krognæt*, which near Hvitávellir is used for catching salmon. This net has two arms, the longer measuring 6 fathoms in length, and the shorter 2½ to 3 fathoms. The width of the meshes is 2¼ inches, and the net is 58 meshes deep. Such a net complete costs from 35 to 40 crowns [about $10]. For a weight a stone is used. This net is not set directly from the shore, but from a stone dam extending from the shore some distance into the stream. It has two openings for the current to pass through, and across these openings nets are extended to catch any fish which might possibly escape by that way. The two arms of the net form a sharp angle. When the fish push against the net they press it into this angle and are retained there. The fish are taken out of the water from a boat, the net being lifted up after the arms have been drawn in.

I heard many complaints of the seals at Hvitávellir. The large gulls also injure the salmon fisheries, as they strike the salmon in the neck when they are in shallow water. Both gulls and eagles render the sal-

mon unconscious by striking them with their beak, and then drag them on shore, where they devour them.

We crossed the river near Grimsá, where some small trout were caught, but where we did not find any salmon as we had expected; and by way of Andakill reached Grund, on the Skorradals Lake. In its western portion this lake is 12 fathoms deep, but at the other end it is said to reach a depth of 20 fathoms. It is said to be 2½ Danish [about 12 English] miles long and of considerable breadth. The mountain-trout found in this lake are called *blásilung*, and frequently some are caught weighing 9 pounds. In this lake the trout never become so large and fat as the mountain-trout. I did not succeed in catching any fish. The water of this lake is very clear, and here and there on the bottom may be seen patches of Myriophyllum. The *blásilung* is said to spawn on stony bottom during September and October.

In the river Laxá there were caught in 1884 about 260 salmon near Leirá. The fish go up as high as the Eirafos Falls. Great complaint is made of the seals, of which I noticed several hundreds. The river Laxá has an excellent fall towards the sea and forms a series of natural steps. The salmon can easily leap all the falls formed by these steps. The river has a tributary called the Baugdá, which comes from the small lake Medallfell, to which the salmon ascend, and are caught in a salmon-trap at the place where the river leaves the lake. The bottom of the river is partly lava and somewhat loose masses of rock. The salmon do not ordinarily ascend this river till about the 10th of June, but occasionally they come as early as the 25th of May. The largest number come from June 24 till July 1, and about August 20 they stop coming. In 1884 about 700 salmon were caught, but among these there were many small fish which should never have been caught. There are also many salmon-trout, but only few mountain-trout. Sira Thorkil Bjarnason, of this place, thinks that fishing is carried on to excess, and that this is probably owing to the circumstance that the fisheries have been let to Englishmen who did not know how to fish, while they paid from 800 to 900 crowns [about $225] for the summer season. Seals are not numerous in this neighborhood, as they are hunted a good deal.

Thingvalla Lake is said to cover an area of from 4 to 5 Danish square miles. Its depth in the northwestern portion is said to be 80 fathoms. In many places the bottom consists of sand and gravel, but generally it is a lava bottom with numerous fissures. Here and there it is covered by vegetation. Unfortunately the continued bad weather prevented me from making many observations. We could barely undertake a little trip in a row-boat. All the following information was furnished by Sira Jens Pállson, who takes a deep interest in the fisheries, and who may be considered entirely reliable. The natural conditions of the Thingvalla Lake (the most important lake in Iceland) are, moreover, so

well known in their general outline that it is not necestary to give a detailed description. The fish found in this lake are the following:

The trout, when it comes up the Oxará River to spawn. It reaches a weight of 22 pounds. By fishing through holes in the ice a number are caught weighing 20 pounds each. The spawning season lasts during September and October. It begins about September 15, and generally ends in November when ice begins to form. The trout does not like ice. The trout are also said to spawn in shallow places near the shores of the lake. It could not be ascertained when the young fry leave the river.

The *blekja* reaches a weight of from 1 to 7 pounds. During summer some of them go up the river. They are generally caught near the coast in shallow water. Of late years attempts have been made to catch these fish farther out, at a depth of from 20 to 30 fathoms, with lines having from 500 to 600 hooks; but these attempts have not been successful, only about ten fish having been caught. The *blekja* spawn after July 15, and the spawning season is at its height from July 20 till August 1. The spawning place is about half a mile from Thingvellir, and has a stony bottom. The spawning season is, at different places, continued far into September. The fish are fattest in spring when the ice begins to break.

The *depla* is a smaller fish, about 12 inches long, and weighing scarcely one pound. Mr. Pállson thinks that it is a small trout, while others are of the opinion that it is a separate species. These fish are caught at the southern end of the lake.

The *murta* is about 6 or 8 inches long, and looks like a young *blekja*. It is said to spawn from the middle of September till November, at the same time as the trout.

I had an opportunity at this lake to see some of these fish in single specimens. The summer *murta* is certainly only a young *blekja*, and it is therefore also called the "barren *murta*." The *blekja* which spawns in July has a red belly and whitish fins; but those which spawn in autumn have a lighter color and their fins are not white. It is probable that the *blekja* which spawns in summer comes from the deep sea. In the stomach of the *blekja* which I examined I found a great many snails, and in the trout I found many young *blekja*.

From Reikiavik I several times visited the river Ellidará and noticed its course and its tributaries, but without making a thorough examination of it. Its wealth of salmon is owing to the favorable condition of its fall, and to its bed of lava with numerous hidingplaces. The salmon found in this river and its tributaries are said to be small.

From the above it will be seen that I visited a large number of the Iceland lakes and rivers. It is true that I failed to visit some important rivers, like the Torsá and the Olufsá, and that I did not examine the Thingvalla Lake as thoroughly as I would like to have done; but my time was limited, and, even if I had had sufficient time, the unfa-

vorable weather which prevailed in the southern part of Iceland during 1884 would have seriously interfered with my observations. Investigations of this character should be continued for some length of time before definite results can be reached, and repeated visits should be paid to most of these localities, and their natural conditions should be examined more thoroughly. I felt this particularly on returning home and looking over my notes and collections. There is no doubt that another visit to Iceland, made about a month earlier than my visit and extended to some rivers and lakes which I failed to see, would serve to furnish a more reliable basis for observations. It should not be forgotten that this is the first attempt which has ever been made to describe the Iceland fresh-water fisheries. Neither Eggert Olafson, Bjarne Poulsen, nor Fâber and others have given reliable and full descriptions of these fisheries, and of the natural conditions under which they are carried on. I had to begin from the very beginning, and had no previous observations that could in any way be relied on, wherefore my work must be considered as merely a first attempt.

It is quite natural that, in view of the large number and extent of the rivers and lakes of Iceland, and of the vast quantity of water contained in them, at least during part of the year, we should inquire what economical value they possess as fishing waters. It should at the same time be remembered that something more than water is needed for the life and well-being of fish, and that the weather and the character of the land surrounding the water are of the greatest importance. The weather prevailing in Iceland at certain seasons of the year proves a great hindrance to the life of fish, and the character of the country has a great influence on the number of fish in the fresh waters of Iceland.

The cold weather not only hinders the development of plants and the lower animals in the watercourses and lakes, but it also produces physical conditions which hinder and destroy the life of fish. It is an old saying in Iceland that those rivers which come from the mountains, and which have a whitish color from the inorganic matter which they carry, nevertheless contain salmon, as these fish do not seem to shun muddy water, especially if through it they can reach clear watercourses which they like. But most of the mountain streams are so cold the greater part of the year, and have so much ice, frequently just before summer sets in, that the spawning salmon and the young fry are exposed to considerable danger. The ice dams up the water and disturbs the bottom, carrying along stones and gravel and forming new channels for the water; and it may well be said that where the ice is found in large masses the fish decrease in number. If the cold weather continues for any length of time much bottom-ice forms in these waters, which, when milder weather sets in, rises from the bottom, carrying away sand and gravel and the fish eggs which may be concealed in it. This influence of the ice on the life of fish has been observed in several waters, and in Iceland this is a matter of considerable importance.

There is, moreover, a good deal of rain and snow in Iceland, and all the watercourses are therefore quickly filled with water at the time of the year when the current becomes stronger. Some of the watercourses, therefore, have an entirely different character in winter from that in summer and spring. It is also well known that when there is much rain even the smallest brook in Iceland becomes a rushing torrent which is dangerous to pass. As the mass of water rises and the swiftness of the current increases, the fish of course find it exceedingly difficult to maintain themselves in such streams. On the other hand, low water in summer will, on account of the pure and transparent water of many streams, render it difficult for the fish to hide themselves. Unless they find hidingplaces on the bottom, they will become a prey to their pursuers. Many Icelanders say that, owing to the clearness of the water in the fishing places, the salmon are spied from some projecting rock before the net is cast.

The nature of the surrounding country is at least of as much importance for the life of fish as the weather. The salmon waters of Iceland cannot expect much from the surrounding country. Vast deserts, often covered by enormous masses of snow, or consisting of nothing but stone and sand, with a very scanty vegetation, are not favorable to the development of animal life. The valleys are limited in extent, and contain but little humus or vegetation where animal life can develop. It will, therefore, also be seen that wherever the streams and lakes contain many fish there will be a good deal of grass and many bushes.

The character of the Iceland streams varies a good deal. There are some which flow gently through a flat country; and there are rushing mountain torrents, which flow rapidly from their source to the place where they empty into the sea. These latter must be considered as being very poor fish-streams. There are other streams which have a rapid current, but they have along their course calm places, with a gravel or sand bottom, and holes and depressions, where the fish can during the daytime hide in deep water. These streams are better adapted to fish as the number of these holes increases; that is to say, if they possess other conditions which are necessary for the life of fish. The Iceland streams have one advantage over the streams in the rest of Europe which contain salmon, as their bed for long distances is filled with lava, or as the stream has taken its course over lava-beds. The fissures, holes, and steps of the lava not only furnish excellent hidingplaces in these clear streams, but in lava-beds springs are frequently met with whose temperature remains nearly the same all the year round. The importance of this circumstance in a country like Iceland need hardly be explained. It may be proper, however, in this place to contradict the common idea that warm springs are particularly favorable to the development of the life of fish. Warm water may accelerate the hatching process of fresh-water fish spawning in winter, but this is more harmful than helpful, because the early hatching of the salmon

eggs would expose the young fry to great danger whenever there was a thaw in the tributaries where the water is not warmed from hot springs. It is evident, however, on the other hand, that there is some truth in the old saying that fish in watercourses warmed by hot springs get fatter than fish in common watercourses, as warmth increases the lower animal life, and thereby produces more food for the fish.

I have in several places in Iceland caught fish in watercourses whose temperature was low, which had a very barren bottom, and whose surrounding country was bare of plants and animals. Under these circumstances the number of fish was small, as they were obliged to go over a large area to get their food. They were always half starved and very lean. Their stomachs contained all kinds of small animals which the wind had cast into the water, such as beetles, gnats, spiders, and flies, and also all sorts of articles carried away by the water, as pieces of wood, leaves, buds, &c. This shows plainly that, although these streams may have a great deal of water, the number of fish in them will be limited.

There is another circumstance connected with these streams which should be noticed. They vary in course of time, often to such a degree as entirely to change their character as fish-streams. The Norwegian geologist Helland and the Icelander Thorvaldur Thoroddsen have shown that those fiords into which mountain streams empty have gradually been filled by the mud and gravel which these streams carry. At the mouth of such rivers there are large masses of sand, which have gradually filled the fiords into which these streams empty, while the clear rivers empty into deep fiords with an unobstructed mouth. The Héradvatn has heaped up large masses of sand at the bottom of the Skagafiord; the same applies to the Blandá; and the Hvitá has carried so much mud and sand into the Borgarfiord that, according to Thoroddsen's statement, small boats cannot enter when the tide is out. But the salmon must have a free current and fresh water in the mouth of the river which it visits; and wherever it finds sand-drifts, mud, &c., it will keep away. It is evident that these circumstances, in rivers like the Blandá, decrease the number of salmon. This is certainly more likely to be the reason for this decrease than the casting of peat ashes into the water, the digging of peat, or noise.

The Iceland lakes are of considerable importance to the fresh-water fisheries of this country, as they contain a vast number of trout and mountain-trout, which form the object of fisheries, but not to such an extent as might be desired. In some places the farmers go up on the high plateaus to fish in the numerous lakes, and bring home a large quantity of dried, salted, or fresh trout. It is a fact that the life of fish in these, as in nearly all the fresh waters of Iceland, is dependent on the enormous masses of gnats and flies found near them. The mountain-trout, especially, lives on these insects and roots in the bottom, which is filled with the larvæ of flies. I have examined several fish

from these lakes, and have always found the stomach of the mountain-trout full of insect larvæ, while the stomach of trout contained snails and some young fish, generally the young of the mountain-trout.

The Iceland lakes which I visited greatly resemble each other, and, properly speaking, there are only three which are distinguished from the others, namely, the Myvatn, the Svartárvatn, and the Thingvalla. These three lakes have much in common, particularly the circumstance that subterranean springs will furnish all the year round a supply of evenly warm water, and the many fissures and holes which serve as hidingplaces for the fish, and to a certain extent make up for the lack of vegetation.

But the lakes have another advantage. I do not refer to the saying so common in Iceland, that all watercourses which spring from lakes containing fish will have fish, because I am inclined to the opinion that the fish rather come from the rivers into the lakes. Some small lakes, however, are of importance to the salmon rivers to which they belong, if the salmon can get up into them or pass them. These lakes furnish a safe place of sojourn for the salmon which during the course of the summer have gone up into fresh water. The remarkably clear water of the streams, their low water at certain season of the year, and the ease with which fishing can be carried on in them, are very dangerous to the salmon when about to spawn and propagate its species. If the salmon can hide in a lake while its sexual organs are approaching maturity, there will be all the more prospect that it will spawn. Such a lake need not be particularly large, and in Iceland a widening of the stream or an inaccessible canyon between the rocks will yield good results, which will be still further improved if the bottom contains lava. It will be found that some of the best salmon waters of Iceland show these conditions; as, the Laxá in the Tingöre district, the Laxá near Hunafliot, the Laxá near Kjos, and the Laxá (Ellidará) near Reikiavik. It is not by accident that these rivers have got the name "Laxá"—salmon-river. The chief fish of economic value found in the fresh waters of Iceland are the salmon, the trout, and the mountain-trout. There is also a variety of the eel which is peculiar to Iceland. Of other fresh-water fish, I might mention the *Gasterosteus aculeatus*, which, however, is of but little importance.

Both the mountain-trout and the trout are indigenous in the fresh waters of Iceland, and do not leave them—that is, there are tribes of these fish which always remain in the water where they have been hatched and have grown to maturity. But besides these there are tribes, both of trout and mountain-trout, which for a time stay in the sea, and which go into fresh water only to spawn. It is difficult to ascertain how far out to sea they go, but near the Ofiord I have observed all the varieties of the trout and one variety of the mountain-trout, either in the fiord or going up into the streams. I have observed the same in the Southland, and it is nothing strange to see the mountain-

trout go from the seas which surround Iceland up into fresh water, as has been seen on the coasts of Norway, Finland, and Spitzbergen.

It is well known that the salmon go into fresh water solely for the purpose of spawning. For this purpose they come as early as April, and continue to ascend the streams till August. We do not, however, possess any absolutely reliable information in this regard, and it must be presumed that the ascent of the salmon in the Iceland waters is very much influenced by the weather. Not much is known as regards the spawning season, but it scarcely comes before October, although, as has been said above, salmon eggs have been observed in the Hvitá in September. It is possible that there is some mistake about this, as probably also with regard to the statement that spawning salmon have been noticed in the mouth of the river. It must be supposed that the salmon eggs found in the mouth of the river, if they really were salmon eggs, were dead eggs, which by floods or in some other way had been carried away from the spawning places. The common people in Norway also frequently cite the presence of eggs in such places in proof of the assertion that the spawning places of the salmon are at the mouth of the river, or even on the shore; but A. Landmark [the Norwegian inspector of fisheries] states distinctly that such eggs are always dead.

It is very difficult to obtain any information regarding the spawning season of the fish in the various Iceland waters, because very few Icelanders have much knowledge of the life of fish, or have any idea of the importance of such knowledge; and from the same causes it is of course still more difficult to find out how long the young salmon stay in fresh water before they go to the sea. It is of no little importance to obtain some light on this subject, for if the young salmon stay in the rivers for a considerable length of time before they go to sea, they are exposed to the numerous dangers of the Iceland rivers. In Scotland, owing to the favorable conditions of food, salmon develop in from 14 to 25 months. Landmark thinks that in Norway it takes 12 months longer than in Scotland; and that hardly any young salmon in its silvery traveling dress, which the English call "smolt," goes into the sea before it is two years old or more. I do not put much faith in the various statements regarding this subject which I have heard in Iceland, as I have not met a single Icelander who showed any familiarity with this subject. Thus I have been told that English amateur fishermen have from time to time caught smolts, which, according to English custom, they again threw into the water. But it struck me as very strange that among the thousands of fish which passed through my hands in 1884, I only once found a young salmon (near Laxamyri), and this fish was still in its trout stage. It might be supposed that the young salmon of the Iceland streams went to sea at an early age, owing to the lack of food and the unfavorable natural conditions.

The apparatus which the Icelanders use in the fresh-water fisheries are not of a nature to endanger or exhaust the fisheries, and it certainly

cannot be maintained that the decline of the salmon fisheries is caused by the apparatus. All the nets are either incomplete or so poorly made that they barely answer the purpose. The stationary nets are, as a rule, too small, and the seines do not float well in the water. The materials (hemp, wool, wood, and bone) do not at all answer the requirements of modern fishing apparatus. I will only mention, as an illustration, that the bones which are used as sinkers scare away fish that are as shy as the salmon is known to be, by their white color. The salmon-traps near Laxamyri and Ellidará do not deserve any special notice. It is a great mistake, however, that salmon are frequently caught in Iceland with hooks by beating the water at hap-hazard, as these hooks enter deep into the body of the salmon and entirely spoil its appearance and value.

As the salmon fisheries are at present carried on in Iceland, there is no danger that the salmon will be exterminated. But many Icelanders cannot see a salmon within their reach without killing it. They have no idea of leaving the fish in peace during the spawning season; and although there are laws on the subject, many Icelanders pay little attention to such regulations. The apparatus are frequently left in the water so long that they are in danger of being lost. In spite of the many complaints of the decline of the salmon fisheries, the Icelanders, who in many other respects have to rely on their own resources, have no idea that much could be done to improve matters. In olden times, when the salmon were not an article of trade but only an article of food for home consumption, there was some meaning in the regulation that the salmon should be allowed to go into any man's waters. At the present time the alternative is, either to let the entire country enjoy an economical advantage by increasing the value of the different waters, or to let each Icelander have a salmon in his own pot. This may be pleasant enough, but a wise economy would prefer to increase the value of all the waters.

Some choice has also to be made between the salmon fisheries and the seal fisheries, if the former are to be preserved and developed. Here likewise we are confronted by an old saying which is quite common in Iceland, namely, that everything is good as it has been handed down from olden times. This may have been true enough until the exportation of salmon assumed larger proportions; and it may still apply to the seal fisheries, but certainly not to the salmon fisheries. If the Iceland salmon fisheries are to be preserved and developed, the seals should be hunted at all times and in every possible way. The seals destroy a large quantity of salmon. They eat nearly all fish, but they prefer salmon, for the same reason that we like salmon if we can get it. Seals may, therefore, be observed at the mouths of all salmon rivers, and if they chase them up the rivers, they have certainly previously decimated them. A simple sum will illustrate this, and, to understand it, it should be remembered that it is a natural necessity for the salmon to go up the rivers. Let us suppose that a man every year

kills 100 seals, and that he gets 10 crowns [$2.68] for each—a price which, however, he will rarely get in Iceland. This yields him a net income of 1,000 crowns [$268]. I will further suppose that these seals have lived 4 months (120 days) near the mouth of some river, and that every day each seal has devoured 5 pounds of salmon. They would, therefore, have destroyed 60,000 pounds of salmon, to the value of about 20,000 crowns [$5,360], at a low calculation. It is easy to draw the moral from the above.

It is not easy to say what income the Iceland salmon fisheries yield at the present time; or, at least, I am not in possession of the necessary data. It is said that about 500 tons of salt salmon are exported every year. This is certainly not much, but in time this quantity might be increased, and the salmon fisheries would certainly yield better results if the salmon were properly treated. This should be the aim of all progressive fishermen in Iceland. Among other things I would recommend packing in ice, slighter salting, and smoking. The question of packing salmon in ice is at present discussed in Iceland, but no definite conclusion has as yet been reached. At present the Icelanders salt their salmon too much, and most fish dealers would prefer salmon which is not salted so much, as salmon salted in this manner are not so valuable as an article of trade. Hence, it would be worth while to try a better method of salting.

One difficulty, however, will always have to be contended with in Iceland: the fishing places are generally at a considerable distance from each other and from the trading stations. Transportation becomes expensive and difficult if the fish (as should always be done) are salted or packed in ice immediately after they are caught.

The seal fisheries should be free to every one, so that the greatest possible number of seals would be destroyed. As both the trout and the mountain-trout are dangerous enemies of the eggs and the young of the salmon, they should not be protected. The trout fisheries should therefore be free, except in the spawning places of the salmon, from September till May 1. The people living along the salmon streams would therefore not have to forego the pleasure of eating fresh fish.

The deep Thingvalla Lake, which contains a great many fish, is a lake where salmon might be introduced with advantage. It is well known that in some inland lakes there is a variety of the salmon which never goes to the sea, and of all the Iceland lakes the Thingvalla Lake is the one particularly adapted to this kind of salmon. For this reason about 3,000 nearly-hatched salmon eggs were, during the winter of 1884–'85, brought to Thingvellir, where they are further developed, and the young that are hatched will be placed in the Oxará. It is the intention to place several thousand young salmon in the Thingvalla Lake every year, and thus to provide this lake with a good stock of this fish.

There is but little occasion to make experiments in introducing finer kinds of fish. The few kinds of fish found in Iceland are all of such excellent quality that it would hardly pay to introduce others.

Vol. VI, No. 12. Washington, D. C. Sept. 7, 1886.

55.—FISH AND OYSTER CULTURE IN THE PROVINCE OF VENICE.*

By ALEXANDER P. NINNI.

FISH-CULTURE.

The Lagoon of Caorle is situated between the lower portions of the rivers Livenza and Tagliamento, and is laved by the waters of the sea at the ports of Falconera and Baseleghe. Several streams empty into it, producing a hurtful mingling of the waters and hindering their course at the time of high water.

By the law of June 25, 1882, a portion of this territory, containing a population of 30,356, was comprised in the first works of public improvements; and the firm of Grego, in 1883, presented a memorial to the ministry of public works, through Mr. Lionello Grego, making the proposition (which was accepted in a general way) to convert the lakes and swamps into fish-ponds, instead of either filling them or laying them dry by a mechanical process. In this way it was thought that the object which the law had in view would be reached, viz, to remove the miasmatic effluvia developed by the mingling of fresh water with the waters of the sea.

In constructing the large fish-pond, all the fresh water would be separated from the salt water, thus preventing the generation of dangerous effluvia, it having been shown that low grounds inclosed by embankments and covered only by sea-water do not show these miasms, but are always found to be in a satisfactory hygienic condition.

As this fact cannot be doubted, the question would have to be viewed not only from a hygienic but also from an economical point of view, while the problem could be solved, in part at least, with a very small expense, by utilizing these vast marshes for the raising of fish instead of reclaiming them.

In consideration of these circumstances Messrs. Grego intended to devote to fish-culture and shell-fish culture a large part of their marsh property.

I at once made a preliminary visit to the locality in question, having the good fortune to be accompanied by Messrs. Giuseppe and Lionello Grego, from whom I was able to obtain all the needed information. I commenced my journey at Val Nova (belonging to Grego). This is a fishing and hunting ground which covers 5,607.87 square rods.

* *Progetti per estendere la pescicoltura ed introdurre la coclеocoltura nel fondo situato nei comuni censuari di Lugugnana e Caorle in Distretto di Portogruaro, Provincia di Venezia.* Rome, 1885. Translated from the Italian by HERMAN JACOBSON.

The importance of these grounds will be be seen from the following data:

Approximate quantity of young fish planted or which could be planted in Val Nova.

Kind of fish.	Actually planted.	Capacity.
Chrysophrys aurata	40,000	150,000
Mugil auratus	120,000	200,000
Mugil capito	170,000	400,000
Mugil saliens	300,000	400,000

Notwithstanding the insufficient quantity of fish planted, the products in the years 1882, 1883, and 1884, respectively, were 22,214, 20,254, and 23,757 kilograms of fish of the following kinds:

Anguille, *Anguilla vulgaris*, Fl.
Labraci, *Labrax lupus*, Cuvier.
Muggine cefalo, *Mugil cephalus*, Cuvier.
Muggine orifrangio, *Mugil auratus*, Cuvier.
Muggine calamita, *Mugil capito*, Cuvier.
Muggine musino, *Mugil saliens*, Cuvier.
Latterini, Gen. *Atherina*.
Orate, *Chrysophrys aurata*, L.
Muggine chelone, *Mugil chelo*, Cuvier.
Gobio gò, *Gobius ophiocephalus*, Pallas.
Granchio di mare, *Carcinus mœnas*, Leach.

One can see from these examples how the fishing industry flourishes in the estuary of Venice, and that it deserves to be aided by the Government. The marine fish-culture of these grounds, or so-called "valleys," is one of the most ancient and best-managed branches of industry, and is far ahead of anything of the kind found in other countries.

The neighboring piece of ground of about 3,700 acres, which, if an embankment was constructed, would form a large new valley, has more extensive and deeper natural canals than the former.

I traversed these grounds in every direction, and found them well adapted to the purpose for which they are intended, possessing, besides the canals, swamps, ponds, and lakes, and along its circumference some solid soil, which would render the construction of the embankment easier and much less expensive. This part of the lagoon is, in my opinion, but poorly adapted to form inclosed grounds, containing nothing but reeds, owing to the low tides prevailing, especially in the extensive swamps found in these grounds; but, on the other hand, they are extremely well adapted to be transformed into inclosed fishing and hunting grounds.* I advised Messrs. Grego to use every possible means to reach their object, because I feel certain that the proposed inclosure of these grounds will prove a very safe and remunerative speculation, as will be seen from the following data.

* The cultivators of these "valleys" also take into account the products of the chase, which in some valleys amount to 2,000 to 4,000 lire [$400 to $800] per annum.

Guided by practice and a proper knowledge of the locality, it may be safe to say that the following quantities of fish could be planted and reared in the new valley:

Kind of fish.	Capacity.	Annual Product.
		Kilograms.
Chrysophrys aurata	600,000	36,000
Mugil auratus	1,000,000	50,000
Mugil capito	3,000,000	33,000
Mugil saliens	4,000,000	50,000
Mugil cephalus	100,000	25,000
Labrax lupus	150,000	8,500
Mugil chelo	100,000	6,250
Eels	....	30,000

In this calculation the smaller fisheries have not been taken into account—such as the fisheries for *Gobius ophiocephalus*, *Atherina*, *Carcinus mænas*, &c.—which ought not to be despised.

That the conditions of this site are most favorable appears not only from practical observations, and from those which I made during my visit, but also from a comparison with the adjoining Val Nova and the grounds which it is proposed to inclose.

In the first the *Mugil cephalus*, when one year old, weighs 8 to 9 ounces, in the second 12 ounces, and when two years old it reaches the weight of 35 ounces. A larger size and heavier weight are also noticed in *Labrax lupus*, *Mugil chelo*, &c., of the same age.

These facts may be caused by the absolute liberty which the fish enjoy, and if compelled to remain within an inclosure the fish would not find themselves under the same favorable conditions. But I believe that it is sufficiently proved that this new locality offers all the conditions necessary for the growth of fish.

The expense of inclosing this valley will be very considerable. The embankment surrounding it should be 2½ meters high, and on the side where it is most exposed to the prevailing winds it should be covered with Istria stone, of which 1,000 cubic meters will be needed, costing 6½ lire [about $1.30] per cubic meter delivered. From an approximate calculation made by Mr. Lionello Grego it appears that the entire expenses, including embankments, five sewers, ditches, fish-ponds, dwelling-houses, &c., would not be much more than 200,000 lire [about $40,000], a sum which must be considered small compared with the results which may be obtained.

OYSTERS.

From ancient times there have been oyster-beds in the Venetian lagoons, on which oysters four to six months old were planted which in a very short time became fit for the market. These places not only serve as oyster reserves, but also as parcs for reproduction, as the oysters flourish here to a remarkable degree, and sound spawn becomes fixed

to poles and fragments found at the bottom of the water, so that every available surface is soon covered with diminutive oysters, which in a few months have reached a considerable size, and have a very fine flavor. Shell-fish culture in the estuary, from reasons more or less well known, is at present in a state of decline.

There are in our waters two kinds of oysters: the sea oyster and the lagoon oyster, there being two varieties of the latter kind, namely, the marsh oyster and the canal oyster. The sea oysters equal the lagoon oysters in size, but do not have so fine a flavor, as owing to the different food they have a somewhat sharp taste, described in the vernacular of the district by the term "*marinazzo*" (flavoring of the sea), which is not pleasant to epicures. This kind is at the present time found in the sea in considerable quantities, and also forms more or less extensive beds, which, however, have been almost exhausted by the fishermen, owing to the great demand for oysters.

Among the lagoon oysters the most highly esteemed are those taken in swamps which are not very deep. They have a pleasant flavor, a dark-green color, and equal in price the best oysters known. These mollusks found in the estuaries generally live isolated, and at any early age usually become fixed to some little shell of *Cardium*, *Venus*, *Trochus*, *Murex*, *Cerithium*, &c., which, when the oyster is taken from the water, will always be attached to the lower shell near its apex. For a time this oyster was very common throughout the entire lagoon, both in running and stagnant water, but now it has become less frequent, and, in fact, has almost disappeared from the greater portion of these marshes.

The threatened destruction of our best mollusks is probably caused by the influx of fresh water in the lagoon, and chiefly by the tracts of cultivated ground which bring about conditions which are hurtful to the life of the oyster and other shell-fish. It seems that similar causes have made the oysters become scarce in other parts of Italy.

This hurtful influence has also extended very rapidly to the lagoon with running water, doing serious injury to the oyster grounds nearest to the mouth of the port, in which during the last few years young sea oysters have been scattered, which after a certain time had reached the size and acquired the flavor which is demanded in the markets, without, however, equaling in flavor those raised in the marshes.

This condition of affairs caused several attempts to restock these marshes, among which there deserve to be specially noticed those made by Chevalier D'Erco, who, not being acquainted with our peculiar hydrographic conditions, attempted to pursue in the estuary of Venice the method of oyster culture employed in the Bay of Arcachon and along the coasts of France and Belgium. The reservoirs (*claires*) of D'Erco constructed along the canal of Sant' Antonio, near Burano, which I visited several times, proved a failure, as practical men had predicted, as neither the oysters nor the mussels could bear the heat of the sun, which heightened the temperature of the inclosed water and increased

its saltness. While, as a general rule, the oysters in the reservoirs in the middle of the swamp perished, excellent oysters, though not in great abundance, were taken from the Canal Sant' Antonio. The conclusion which may be drawn from this circumstance is, as I have already stated, that fresh water is not injurious to the life of the oyster.*

Another experiment was recently made by Count L. Torelli, formerly royal prefect of Venice. He appointed a commission, of which I was a member, for the purpose of studying the question of oyster culture and proposing more efficient means of promoting it. This commission went all over the lagoon, looked for places suitable for the reproduction and rearing of oysters, studied the causes which are injurious to the life of the mollusk, and reached the conclusion that the principal cause is the influx into the basin of the lagoon of fresh water coming from the adjoining land, which, possibly in conjunction with other less known causes, produces a slow but continuous change of the water, making it in many places less and less adapted to the life of the oyster. As the lagoon regulations prohibited the inclosing of this lagoon, in which perhaps the most successful attempts at oyster culture might be made, the commission had to exclude from its consideration this entire vast region. The labors of the commission were restricted to the lagoon of Venice, and for this reason it did not visit any localities outside of these limits.

As the ministry of agriculture had expressed its desire to promote the raising of mollusks on the shores of Italy, and to encourage the planting of new shell-fish, it was natural that among the persons who, provided with the necessary means, responded to this appeal were the enterprising Messrs. Grego, who asked the authorities for their support, so as to enable them to carry out a plan which would prove a great advantage, not only to themselves, but to all the inhabitants of this neighborhood.

A distinguished and highly-intelligent marsh cultivator, the Chevalier Antonio Bullo, wrote that our sea-coasts in the province of Venice are no longer adapted to the raising and cultivation of oysters. Both by the sand which is brought by the many rivers emptying into the sea along this coast and by streams of fresh water, which abound in this coast region, these coasts have become such as not to justify any expectations of favorable results in oyster culture.†

Chevalier Bullo's opinion appears to me to be somewhat too absolute, as long as it has not been proved by practical experiments, but nevertheless deserves to be taken into account, as coming from a person having great experience in all matters pertaining to the fisheries.

I must say that I do not altogether share Chevalier Bullo's opinion, as attempts at oyster culture could be made in bottoms where there are

* Reference is here made to the mass of fresh water which enters the canal as far as Burano from Porte Grandi.

† The journal *Tempo* for March 27, 1879, No. 73.

not such heavy deposits of sand, &c., and as oysters are found in the Adriatic at a depth of 30 to 40 meters [about 20 fathoms].* On the other hand, we know that young oysters have become attached, in the sea near Taranto, to fascines placed on banks at the depth of 30 meters. As regards fresh water, facts have proved that it is not injurious to the life of the oyster.

We perfectly agree with Chevalier Bullo in his advice that the lagoons are to be preferred to the coast. Professor Issel, speaking of oyster culture in the Mediterranean, says that the places destined for oyster culture should be well protected from the direct action of the waves. The most suitable places should be looked for in the estuaries, and especially in those parts of the lagoon which are nearest to the sea, and where it is safe to assume that the water is continually renewed.

Another reason in favor of this selection must be found in the fact already referred to that the oysters from the quiet waters of the lagoon have a far better flavor than those from the sea, and are therefore more sought after by dealers.

The above-mentioned conditions are not easily found, and I can state that one of the very best locations is the one of which I shall now speak.

It was the intention of Messrs. Grego to devote a portion of their property to the reproduction and raising of oysters, and eventually of other mollusks.

The most favorable region, at least for the raising of oysters, is certainly the swamp of Dossetto, and this entire region is called *Il Merlo*.

In visiting this pond we entered through the principal canal, about four meters deep, which empties directly into the swamp. On its side towards the sea it has a breadth of about 100 meters, but including also the land alongside of the water its extent is about 1 kilometer.

Owing to the proximity of the sea, the water is continually renewed; and, although the average depth of the lake is only 32 to 35 centimeters, the dangers arising from stagnant water do not exist, viz, the higher temperature and increased saltness, which in many of these swamps do a great deal of harm to fish-culture.

The bottom of the pond presents all the conditions which are necessary for the successful raising of mollusks, although a greater depth would be desirable. There are large portions entirely destitute of marine vegetation, while others are rich in plants, particularly *Zostera nana*, which I found fresh and healthy notwithstanding the heat of summer to which they had been exposed during several months, which is another fact tending to show that the temperature of the water is not very high. I observed here and there shells of different mollusks (*Trochus*, *Cardium*, &c.,); and alive I found *Cerythium afrum* D. S., *Nassa prismatica*, *Trochus albidus*, *Mytilus galloprovincialis* (all young individuals), and some other species common in such places.

*Some were also caught about the middle of the Quarnero.

During the second half of May Mr. Lionello Grego had the happy idea of planting 400 young oysters caught in the harbor of Baseleghe, and distributed them in three boxes of pine wood, filled with branches and stones. I believe that this combination injured the growth and development of the oysters. At any rate no useful data resulted from this experiment. The oysters selected for planting were of the following two sizes: 22, 16, and 34, 30,* the first five to six months old, and the second about one year old. Those which I saw on July 30, *i. e.*, after two or two and a half months, had the following dimensions: Size No. I: 33, 21; 32, 25; 30, 23; 33, 17. Size No. II: 50, 47; 48, 44; 53, 56; and 43, 58. They all belonged to the kind *Ostrea edulis* L., var. *venetiana* Issel. They were, to express it in a technical term, "well made," normally developed, and almost entirely free from the small animals and plants which in many places are almost invariably found on oysters.

All, or nearly all, had near the apex of the lower valve the body to which they had become fixed when young (*Venus gallina*, *Murex brandaris*, *Cerithium*, *Trochus*, and *Cardium*). The lower valve of the shell is quite convex, while the upper is flat. In some of them a certain anomaly was noticed, namely, an excessive growth of the margin of the lower shell, which prevents the two halves of the shell from closing perfectly, a portion of the enamel which lines the inside of the shell being exposed.

From this place I went to the port of Baseleghe, and visited the waters known in the neighborhood by the name of *Carrozza*. I found them to be about 2 to 3 meters deep, and maintaining this depth for several miles out at sea. Here, as in all the places of this neighborhood, oysters develop naturally, and give rise to some fisheries of no great importance, carried on by the inhabitants of Caorle. The *Carrozza* is exposed to winds, and to accumulations of sand, &c., and as far as I can see, there seems to be no means to remedy this evil, and make this locality fit for raising oysters; I doubt, in fact, whether these oysters will ever fetch the same price as the lagoon oysters.

The best oysters which I saw in any of the places which I visited are those from the Canal Canadare (in old times called Canal Dare), which receives its water from the port of Falconera, and runs between Val Nova (the property of Messrs. Grego) and Val Vecchia (the property of the township of Caorle). In this canal the oysters not merely live isolated, fixing themselves to some shell, but have a tendency to form beds, one lying on the top of the other. Their shell is generally curved a little to the right; it is darker than that of the *Carrozza* oyster; the upper valve is not quite so flat, and the lower one is sometimes concave; in various respects, among the rest the brittleness of the shell, it resembles the Taranto oyster. I gathered five having the following dimensions: 82, 78; 90, 77; 86, 82; 90, 83; 54, 33. I found them all fat and of excellent flavor.

* Millimeters. The first indicates the length and the second the breadth.

From my preliminary observations I have reached the conclusion that there is some difference between the two localities Falconera and Baseleghe. Owing to various untoward circumstances,* however, I was not able to take all the observations necessary for forming a definite opinion, and I must, therefore, for the present at least, refrain from pronouncing an opinion on the subject.

I hope during the coming year to make all the necessary observations on the saltness, the temperature of the water, &c., without which it will be impossible to pronounce a satisfactory opinion on the suitableness of different places for constructing oyster-parcs, and to express my views on the manner in which this useful industry should be introduced.

In oyster culture a distinction should be made between places for reproducing and places for raising oysters; it is very rare to find a place which is adapted to both these purposes. I think that the swamp of Dossetto is well adapted to the raising of oysters, but I doubt whether they can be reproduced here; and to get the exact truth of the matter, experiments should be made. With the view to make success more probable, I would not hesitate to place this swamp, which is only about 200 meters from the coast, in direct communication with the sea by an artificial canal. In this way the renewal of the water would be more complete and more constant. In front and by the sides of the mouth of this canal oyster-parcs might be constructed, furnished with small canals, by means of which a sufficient level of water might be maintained, so as better to protect the oysters from atmospheric and hydrographic changes.

The most suitable depth of water both for reproducing and raising oysters cannot be ascertained without a series of experiments. In the Little Sea of Taranto, and in the lagoons of Venice, where oysters are found, there are seen in some places near the surface of the water the leaves of the *Zostera*, which grows on the bottom, but near Fusaro, in shallow water, these plants are not so plentiful (so says Issel). But in our case the proposed new current would no longer permit the temperature to rise too high, and by using little canals for the inclosed spaces intended for reproduction, the excessive current would be avoided, which would carry the embryos into the open sea, and prove a hindrance to their becoming fixed to shells and other bodies (anything having a rough surface), which should be scattered on the bottom.† The free current in the open part of the pond will increase the depth, thus making it still better adapted to the purpose for which it is intended.

Having observed in the *Carrozza* numerous medusas, which, in some cases, might prove injurious, I would consider it useful to keep them

* Among the rest the delay in sending my instruments.

† If the current is too strong, it will be necessary to provide a larger number of mother oysters, which it is not always easy for an oyster cultivator to procure.

out of the new canal by means of fascines, which might also serve as collectors, and of which I will speak below.

The ordinary dimensions of the oyster parc should be 30 by 20 meters, and the embankment should inclose a quadrilateral space, containing 8 to 10 mother oysters per square meter—that is to say, if reproduction is intended. If the object is merely the raising of oysters, 150 may be placed in the same space.

On the coast between Baseleghe and Falconera oysters propagate, and it appears that the number of their enemies is not very great. It is true that I noticed the usual *Murex*, which devours marine shells; but which, as it seems, gives the preference to the *Venus*. I did not, however, see a single oyster shell pierced by a *Vioa* or *Clione*. I believe that the *Carcinus*, the *Pagurus*, and the *Asterina*, which abound here, do not do any harm to the oysters, and I cannot share the opinion of De la Blanchere as regards the first-mentioned species.

Oysters are likewise reproduced in the Canal Canadare, and it would be well to put collectors in both places for a trial. I would always give the preference to fascines, similar to those used at Taranto—*i e.*, about 2 meters long and 1 meter in circumference—proper care being taken not to have too thick stems and too thin branches.

Fascines tied with a cord or zinc wire are to be preferred. They should be raised somewhat above the ground, and attached to a large rock by a cord of broom-corn.

Another practical method is to use pales covered with hydraulic cement, mixed with sand; but they have the disadvantage of presenting fewer points for fixation to the embryos while being carried along by the currents.

A third kind of collector which I proposed, because I think it is well adapted to many points in the localities visited by me, might be formed by a pale, if desirable, covered with cement, to which at a certain height fascines are attached. All that is required would be to ram the lower end of the pale, which should be pointed, into the bottom in a neighborhood where there are mother oysters. When the young oysters are to be transported these pales are simply pulled out. I advised Messrs. Grego to place some of these collectors near the mouth of the canal, which leads to the principal canal of Val Nova.

As regards the spawn, I would always prefer that from the lagoon. There is no difficulty in procuring mother oysters, because they are quite frequent in many places of the estuary; and when it is remembered that one oyster can furnish from 600,000 to upwards of a million of embryos,* there is no fear that the principal elements of oyster culture will ever be wanting, and that the experiment will prove a failure, provided the locality selected is favorable to the life and development of the oyster.

* DAVAINE: *Recherches sur la génération des huîtres.* Paris, 1853, p. 45.

CONCLUSIONS.—From the foregoing facts I conclude as follows:

(1) The fish-culture practiced for many years at Val Nova proves beyond a doubt the suitableness of the lagoon of Caorle for constructing inclosed fish ponds.

(2) The tract selected for the inclosure of new grounds offers every condition necessary for insuring happy and very remunerative results.

(3) The swamp of Dossetto is the best of all the localities visited by me for constructing parcs for raising oysters.

(4) Oysters are reproduced along the coast of Caorle, and in the Canal Canadare, for which reason it would be well if Messrs. Grego could obtain exclusive control of the fisheries, at least in one of the localities, which, owing to the proximity of the Dossetto swamp, are well adapted to the reproduction of oysters.

(5) In the waters of Caorle there is also found the *Mytilus galloprovincialis*, and it is possible that the cultivation of this mollusk could also be carried on successfully.

(6) It is necessary that the Government should issue strict orders for the better observance of the fishery laws, so as to avert the dangers resulting from the destruction of the young oysters, and this not only in the interest of cultivators, but for the preservation of the species.

56.—A REASONING LOBSTER.

By WILLARD NYE, Jr.

While at Bird Island, Buzzard's Bay, Massachusetts, I noticed what seemed to point at reason rather than instinct in the lobster. One had his home for the time in a hole under a rock, where the water was about 5 feet deep. Thinking to catch him, I made a noose at the end of a fish-line, and by means of a stick spread it carefully around the hole; then let down a piece of menhaden, holding it 6 or 8 inches away in front. The lobster soon reached out to take such a nice morsel, when, by jerking the string, I had him noosed around one of his big claws near the end; but after I had him half out of his hole the string slipped off and he got back. However, I had no doubt of catching him the next time, so, spreading the noose as carefully as before, and again letting down the piece of menhaden, I awaited results, when, instead of boldly putting out his claws as before, he first put his feelers through the noose, and, with a waving motion, felt the string all the way around, then pushed one claw under the string and grabbed the bait. Three or four times I tried him with the same result. He first carefully felt the noose all around, then rooted one claw under the string and secured the bait. I finally had to give up all thoughts of getting him, and came away firmly believing that until this fellow dies of old age the lobster will not be exterminated in our waters.

NEW BEDFORD, MASS., *May* 10, 1886.

57.—NOTES UPON THE INCREASE AND DECREASE OF FISH.*

By A. HÜBNER.

The Werbellin Lake, which is about 28 fathoms deep and has very clear water, contained among other fish up to 1850 many marenas (*maräne*, a kind of *Coregonus*) and sticklebacks. During the next ten years the marenas gradually decreased and nearly disappeared, so that during the twenty years from 1860 to 1880 only a few, at most fifteen, were caught per year. From the year 1880 they again increased, without any known human agency, so that in the autumn of 1882 several hundredweights were taken, and in 1885 about 10,000 pounds. The fisheries are carried on in nearly the same way as forty years ago, only transportation to Berlin has become easier and more rapid. As this lake has a season of prohibition in spring, the fisheries were continued (also since 1880) during the autumn, when the marena spawns. It is sufficiently proved that these fisheries have not done any injury, and that the marenas having begun to disappear gradually thirty years ago, without any indication of disease, may possibly have been the work of the sticklebacks. These fish, which in former years were caught in enormous masses, to be used and dried as fish-food, probably ate the spawn of the marenas, so that there was not enough left for reproduction. In favor of this supposition we may cite the fact that when (during the ten years from 1860 to 1870) the sticklebacks also began to decrease the marenas again made their appearance. Nevertheless they again appeared in enormous numbers, when five years previously there was hardly any trace left of them. On the other hand, it is very strange that of the artificially raised marenas which were planted in this lake about eight years ago not one has been seen again. While there were no marenas in Lake Werbellin the public forgot this fish, so that at present no one wants to buy them. Hence they do not bring a high price. The same is true at the large fish-market in Berlin. When alive these fish will not sell at all, and when dead they at most fetch 20 pfennige [5 cents] per pound in the Berlin market. If the sticklebacks have caused the disappearance of the marenas, what has caused the disappearance of the sticklebacks? Is it because they no longer found as food any spawn of the marenas? But, then, the marenas had long since disappeared, when the sticklebacks were still flourishing. Owing to their sharp fins, sticklebacks are not attacked by other fish, and the meshes of the nets used in this lake are too wide to permit of the supposition that most of the sticklebacks had been caught. The fishermen do not know what cause to assign, and are only glad that they have got rid of them.

* "*Rätselhaftes Vermehren oder Verschwinden einzelner Fischgattungen.*" From the *Deutsche Fischerei-Zeitung*, Vol. IX, Nos. 1 and 2. Stettin, January 5 and 12, 1886. Translated from the German by HERMAN JACOBSON.

Besides marenas hake were also found in this lake, and their number was likewise subject to great changes. Whenever in a certain year the spawning process is successfully accomplished and the young fry manages to get through the first summer, the fish from this year can generally be traced all through the fisheries until they have grown to maturity. This process, however, is not so rapid as with the carp, and it takes about ten years or longer before the hake in this lake reach the weight of $1\frac{1}{2}$ to 2 pounds. As frequently many years pass before there is a good spawning year, the set of hake which just happens to be about the right size has to make up for all deficiencies. And if there are several good years in succession, the fishermen are happy. But it also happens frequently that a very numerous set of fish from a certain year does not seem to make any progress, and disappears all of a sudden. Thus one year the quantity of bream spawn, measuring 15 centimeters [nearly 6 inches], in the Lehnitz Lake was so great as to impede the fisheries and keep the fishermen busy removing the little fish from their nets. At one haul during winter I caught 2,500 pounds of this kind of fish, but not a single one was of a salable size. I knew that the quantity of spawn was too great for a lake having an area of about 250 acres. I therefore asked permission of the authorities at Potsdam to catch some of these small fish and transfer them to Lake Werbellin. This permission was granted; but much time had been consumed in getting it, and as I had to let the winter pass, I found but little spawn of the bream in the following spring, and the intended transfer could not be effected. Although the Lehnitz Lake contained some pike and bass, it could hardly be supposed that they had exterminated the young bream. Probably the food of the bream became scarce, so that most of the bream perished, giving the survivors a better chance to grow and develop. A similar case occurred as regards perch in the Gross Schauener Lake. One summer I caught regularly many small perch which had barely the regulation size. They were too good to be thrown away, and too small for the market. I therefore put them back into the lake, hoping to catch better fish during the following year. When summer came I did not catch any perch, either small or great. The numerous set from the preceding year had dwindled down, and but few remained. I do not mean to say that this will prove an injury to the lake; on the contrary, I hope that thereby the more valuable young bass will flourish all the more. In all these cases I have not succeeded in ascertaining or even in estimating the age and annual increase of the fish, because I did not notice the different sets, until they had become young fish having almost the regulation size. I think, however, that I am prepared to give some account of the growth of the bass in open waters. Even here I can only state the annual increase with absolute certainty from the time when the young bass had almost reached the regulation size; but I possess enough data to enable me to fix the year 1877 as the spawning year. In the autumn of 1881, large masses of these young bass were caught in

the Gross Schauener Lake, which had barely the regulation size—35 centimeters [13¾ inches]—and weighed ½ pound apiece. As my predecessor had to give up the lake in the following year, he took out as many of the then 4-year-old bass as he could possibly get. But their number seemed to have been but little decreased thereby; and as but few bass, either larger or smaller than these, could be noticed, the growth of the fish which had been hatched in 1877 could be traced distinctly. By next year, in the autumn of 1882, these bass had reached a weight of ¾ to 1 pound; in the following autumn, 1¼ to 1½ pounds; in 1884, 2 pounds; and this autumn (1885) these eight and a half years old bass weigh fully 3 pounds, so that evidently the largest increase of weight has been this year. If I had caught many of the young bream referred to above a year sooner, or taken out the young perch sooner, both these kinds would possibly not have disappeared. It probably has not been a mistake to take the young bass so soon, as otherwise they would have died out of themselves. As it is, they have so far been caught in large numbers every year; and in spite of this there are many left, while but few older or younger bass are caught. But the most convincing proof of the fact that extensive fishing is not injurious as long as there is a good stock of fish, is furnished by the quantity of marenas in the Werbellin Lake.

These and similar cases have not been thus far generally made known, although the fishermen could give many such instances. A general and sudden dying out of fish becomes known much quicker, because it is more striking, and because the proofs of the occurrence are evident. The causes of such occurrences are frequently ascertained to be impure or poisoned water. The lack of fresh air also is dangerous, especially in winter when the ice is thick. But it also happens that only one kind of fish dies out, while others continue to live and flourish. Thus eight or ten years ago all the bass in the Strauss Lake died at the same time; and it was impossible to surmise the cause, for it can hardly be supposed that it should have been caused by a thunder-storm; and as the lake is very large and deep, it is not easy for its water to become impure or too warm in summer. In consequence those fish of which there is an abundance have to be caught more freely; but, on the other hand, it will be advisable to aid those fish which are not found in such large numbers by prohibitory measures, or by planting young fry. In this respect I can record rapid success as regards tench and eels. But as this can be done only in inclosed waters, or wherever the fisheries are managed by joint stock companies—of either of which we have none too many—we shall hardly be able to look for any rational fisheries.

If we ask how it comes that in one year there is so much young fry, and again in several successive years hardly any, many different answers may be given. In one case there may be a lack of good spawning places; then again the weather may have been unfavorable; and in other cases

some poisonous matter or mold may have attacked the eggs. Much harm to the eggs and fry is done by the different enemies of fish and by the fish themselves. One spring I impregnated bass eggs and fixed them on juniper branches in wicker-work baskets, which were placed in the water. For three days everything progressed favorably, but on the fourth day I found in the baskets several thousand maggots, which had completely devoured all the eggs. Later I took, for hatching young bass, boxes of fine wire-work, and arranged them in such a manner that they did not touch the bottom but floated in the water, but even then the maggots collected in the boxes and ate the eggs off the juniper branches. It seems, therefore, that these maggots scent the fish eggs. Later they began to attack the young fry. After I had obtained from these wire boxes quite a large quantity of young fry—more, in fact, than I was able to ship at the time—I placed some of them in a puddle in one of my meadows, in order to observe their growth. But I was not to enjoy this pleasure very long. The puddle was full of all sorts of worms, one devouring the other, and all of them attacking the young fry of the fish as soon as they had become stronger than the fry.

It should be remembered that young bass fry are so small and transparent that during the first days they can hardly be seen with the naked eye. In order to learn to know as many as possible of the enemies of fish, I put some specimens of every kind of aquatic animals found in the puddle in a glass and added some hake fry, which can be seen better. At once a fierce war began, one endeavoring to devour the other; but the fry seemed to be sought after by all of them. Thus a salamander, three inches long, had devoured in one hour about forty little fish, both when taking in water and by pouncing upon them. Even a heavy tadpole caught several little fish. Quickly moving and glittering water-beetles and other insects devoured large numbers of fish, while the maggots referred to above seemed to go more for the dead fish, and only occasionally got a few live ones. Of the entire number of small animals and fish, only the salamander and a few beetles remained as conquerors, all the rest having been killed and devoured.

But, on the other hand, the fish themselves are not a whit better than their enemies. Large fish will devour small ones, and their eggs are most eagerly sought after by small and young fish. As young fish, after they have lost their umbilical sac, principally eat small, almost invisible animalcules, as they grow they will take larger food, among the rest the delicate fry of bass. If we consider these known and unknown enemies, and other injurious circumstances, we can easily understand why in many years there is no increase in the number of fish, so that the good years have to make up for the poor ones.

KÖLLNITZ, *December*, 1885.

58.—NEW ENGLAND FISHERIES IN MAY, 1886.

By W. A. WILCOX.

The month of May has been one of excitement and discouragement to the New England fishermen and all interested in the fishing industry. To those that for any reason desired or were obliged to visit British provincial ports threats of seizure and trouble, doubts, and anxiety, with a lack of knowledge as to just what rights they had, caused much bother and vexation, resulting in the seizure of two vessels.

Codfish had been very plentiful on the Western Bank, and vessels returned from short trips with full fares. On George's Bank a fair catch was made. A short distance off Cape Cod fish of good size and quality have been abundant. In Ipswich Bay the catch of codfish has been more than an average one; the gill-nets were taken up and the season ended on May 3, while last year it ended May 12. The total receipts of codfish at Gloucester from all the fishing grounds were slightly less than for the corresponding month of last year.

Halibut have been scarce. From the Grand and Western Banks vessels arrived with less than half fares. The catch on George's Bank was good, the fish being taken in deep water between George's and Brown's Banks. More vessels have been engaged in the catch of halibut than last season, and the receipts show a small increase over those of May, 1885.

The mackerel catch south of Sandy Hook has proved a failure. The demand for all kinds of fish has been very light, and prices lower than for years. Mackerel have not been seen in any abundance. The spring catch has been a failure and financial loss to nearly all engaged. During the month vessels have daily fitted away for the mackerel fishery, 230 sail being engaged at the close of the month. Most of the time the market has been bare of fresh mackerel, and very few have been cured. On May 1 and 2 a severe storm caused the loss of 17 seine-boats. At the close of the month vessels are widely scattered, a large number of them being off Block Island. Many are returning to home ports to refit, not having taken a single mackerel. The first few scattering mackerel caught in the weirs at Cape Cod were taken on May 6; last year it was on May 4. The first catch made in Gloucester Harbor this year was on May 18. On May 14 the first catch was made in the weirs on the Nova Scotia shore; last year it was on May 18. The first arrival at Gloucester with mackerel direct from the fishing grounds was on May 7, being a small lot of 40 barrels that sold for $4.50 a barrel. The weir catch of mackerel at Monomoy and along Cape Cod has been a failure.

Pollock, averaging 10 to 12 pounds each, have been taken in purse-seines off Chatham, Mass.; but the receipts show a decrease from last year. The Taunton River catch of alewives and shad has been of extra large size and quality, with a large decrease in the amount taken as

compared with that of last year. Bait has not been in great abundance, yet the weirs along the Maine and Massachusetts coasts have been better able to supply the wants of the fishermen at all times than last spring, very little delay being experienced and there being no necessity for any American vessel going into any foreign port for bait.

During the month one vessel was lost, the schooner Monitor, of Gloucester, 95.32 tonnage, built in 1884, and, with fixtures, valued at $10,000. While on a halibut trip she went ashore in the fog at Port May, Newfoundland, on May 6; the crew were saved, all else being a total loss.

The fishing treaty of 1818 with Great Britain and the seizure at obscure ports by the British Provinces of two vessels owned in the United States, the charges being violation of the customs laws, have occasioned much interest. Quite a contrast may be noticed between the action of the Canadian Government and that of the United States in a parallel case. The schooner Sisters of Yarmouth, Nova Scotia, was seized at Portland, Me., on May 24 for violation of the customs laws; but as no intention of fraud or wrong-doing was shown, the Canadian vessel was soon released. The two vessels belonging to the United States still remain in the hands of the Provincial officials.

The following was the position of the New England fishing fleet during the last week of May:

Position.	Object.	No. of sail.
Grand Banks, lat. 44° to 46°, long. 52° to 54°	Codfish	160
Grand Banks, lat. 43° to 44°, long. 49° to 51°	Halibut	40
Western Bank, lat. 44° to 45°, long. 60° to 61°	...do	28
George's and Brown's Banks, lat. 41° to 43°, long. 66° to 68°	Cod and halibut	225
Off the coast from New Jersey to Cape Cod	Mackerel	230
Off the eastern coast of New England	Ground fishing	250
On the way to Iceland or Greenland	Halibut	8
Total		941

Receipts of fish at Gloucester, Mass., in May, 1886.

From—	Fares.	Codfish.	Halibut.	Haddock.	Hake.	Pollock.	Mackerel.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Barrels.*
George's Bank	133	2,700,000	325,410	6,000			
Brown's Bank	13	285,000	19,680				
La Have Bank	4	150,000	1,800				
Western Bank	16	1,128,000	100,100				
Grand Banks	34		623,000				
Nova Scotia, Cape shore	1	30,000					
New England shore	23	241,000	11,000	25,000	5,400	414,000	
Ipswich Bay, nets	5	11,500					
Off Newfoundland	1		8,000				
Bay of Fundy	1	20,000					
Mackerel trips, shore	4						480
Total, May, 1886	235	4,565,500	1,088,990	31,000	5,400	414,000	480
Total, May, 1885	283	4,623,900	908,050	1,000	4,000	693,000	5,579

Other receipts in May, 1886: 400 quintals of dried hake.

GLOUCESTER, MASS., *June* 21, 1886.

Vol. VI, No. 13. Washington, D. C. Sept. 11, 1886.

59.–YOUNG MACKEREL DESTROYED BY SMALL-MESHED SEINES.

By B. P. CHADWICK.

[From a letter to Prof. S. F. Baird.]

The destruction of young mackerel along our coast by the use of fine-mesh seines is enormous. I had long known that great quantities of young mackerel were destroyed by the fishermen, but I did not think that the amount was so great until I had given the subject an investigation. The number of mackerel vessels has very much diminished in the last twenty years.

The present method of our fishermen in seining mackerel is such that while taking over 500,000 barrels of good sizable fish, it causes a total destruction of over 1,000,000 barrels of young fish that have grown to one-third the usual size of fully matured fish. Could this number of fish be protected and caught when full grown, the amount would be 3,000,000 barrels; and at the present price of No. 1 mackerel ($15 per barrel) the amount of $45,000,000 worth of food-fish is no small item to our people. The hay crop of Maine, New Hampshire, Vermont, and Massachusetts is 3,150,000 tons. This crop has a market value of $37,800,000. Now, if the farmers should destroy the hay crop annually, the effect upon agriculture in these States would be disastrous; and yet the present method of seining mackerel destroys $45,000,000 worth of food-fish, and scarcely a voice is raised against it.

Mackerel vessels carry from two to four seines each. I have known a single seine to destroy a hundred and fifty barrels of young mackerel in a day in the taking of thirty barrels of marketable fish. If one seine does injury to this amount in a single day, what must be the effect of using the seines of a mackerel fleet of four hundred vessels for ninety days? The ocean is large, and mackerel are prolific. The spawn of a single mackerel is nearly 500,000. Were it not for these two facts, the end of mackerel fishing would soon be reached. As it is, the catch of No. 1 fish is small, there being scarcely any in the market, and these few selling at an exorbitant price. This condition is caused by the destruction of the young fish.

The subject is one that seems to call for immediate attention. Our fishing laws, as regards the coast fisheries, are in a bad condition, and need a thorough investigation; while all our regulations concerning ocean fishing should be well known and the grounds for their existence should be thoroughly understood.

BRADFORD, MASS., *July* 16, 1886.

60.—DEAD FISH ON THE COAST OF RHODE ISLAND.

By HERBERT M. KNOWLES.

[From a letter to Prof. S. F. Baird.]

About the 1st of July hundreds of barrels of small dead fish were driven ashore about 12 miles west of Point Judith. The papers described them as small herring. Similar phenomena are reported from the coast of North Carolina. For the last three weeks immense schools of these fish have been near the shores of Point Judith. They are about three inches long and resemble small hickory shad. I have seen them so thick in the water, which was about 16 feet deep, that the fish on top had to swim on their sides, being literally forced into that position by the mass below.

The point I wish to call attention to is this, that while these fish have been round these shores some little time, no dead ones were seen until the morning after a thunder-storm, the first to occur while the fish were here. Our old fishermen believe that thunder will sometimes kill fish, but I have hitherto regarded that as one of their many superstitions. During the last two weeks I have caught over a ton of bluefish, and upon examination I find that they are not particularly fond of the bait, as their "pokes" contained squid and whiting. The thunder-storm occurred at 1 a. m. on the 8th instant, and at sunrise large quantities of the bait were dead, large windrows of them cast upon the shore for an eighth of a mile distant, and the bottom all white with them in fifteen feet of water.

I inclose clippings from two papers. The oily scum referred to in the second was not seen at Point Judith until after the dead fish, and it may be that it was caused by the decomposition of the fish

UNITED STATES LIFE-SAVING STATION,
Point Judith, R. I., July 11, 1886.

CHARLESTOWN, R. I.—An immense quantity of dead fish were swept by the tide into Charlestown reach on June 18. The fish are strangers to this locality, no one knowing what they are. They are about two inches long, and are of the herring species. The channel connecting Charlestown Pond with the sea was literally lined with them. It is estimated that there were from 200 to 400 cartloads of the fish swept in, and the beach was also lined with them. Large quantities of them have been secured by the farmers for manure. They are fast decomposing. and the stench from them is almost unbearable. Where they came from and what killed them remains a mystery. [From the Providence Journal, Providence, R. I., June 23, 1886.]

AN OILY PHENOMENON.—The people in the vicinity of Raleigh, N. C., are perplexed over a phenomenon that is observed along the southeastern coast of the State. An oily scum on the water extends for sev-

eral miles out to sea, and affects the rivers for a long distance inland, making the surface smooth and calm. Fish are dying by thousands and floating like chips on the surface of the water. It is supposed that they are poisoned by this oily scum, but whence the destroyer comes nobody knows. A suggestion that a ship loaded with oil may have foundered in the vicinity is scouted, because from Lockwood's Folly all the way to Little River the scum is found, and the coast is strewn with the dead fish all the way. In the salt water about Shallotte River and Tubb's Inlet are immense quantities of dead fish of every kind, and it is feared that there are no live fish left in Shallotte River or within 10 miles of its mouth. The water appears to have become as oil, and the wind seems to make no impression on it. [From the Narragansett Herald, Narragansett Pier, R. I., July 3, 1886.]

61.—FISH IN PUGET SOUND.

By J. P. HAMMOND.

[From a letter to Prof. S. F. Baird.]

I have been engaged in the fishing business (making oil from herring and dogfish, and salting and smoking salmon and herring) on Puget Sound for the last seventeen years, and am well acquainted with the different species of fish caught on the sound, and in the Strait of Juan de Fuca.

From 1869 to 1877 it was not an uncommon occurrence for us to catch from 200 to 300 barrels of herring in a night, but since 1877 they have been growing less in number, until now the largest night's work is about 20 barrels. This is a great falling off, and it is much the same way with all other fish on the sound. Previous to 1869 there had been a great business done in catching codfish and winter salmon on the same fishing ground where we catch herring. The cod were dried and the salmon pickled and shipped to San Francisco, but at the time of my coming (in 1869) these two varieties were almost extinct. For then, in an entire season of three and one-half months at the most, we caught 4 or 5 cod with our herring, and it is the same now. This is winter fishing, from the middle of November to the 1st of March.

If we then caught 3 or 4 barrels of salmon, that was considered a good catch, and now 30 or 40 salmon is the best we can do. We have a species of salmon averaging about 7 pounds, which come every year in September and run until October, a space of about six weeks; but they are also becoming scarce, although there is still quite a business done with them. Then there is another species called by white people the hump-back salmon, on account of their getting a large hump on the male salmon's back about the time they are ready to spawn. The Indians call them haddo salmon.

There is also the dogfish, which we catch for the oil contained in its

liver. This has become entirely extinct on some of the old fishing grounds, and on many others where a man with 500 hooks would take from 300 to 500 dogfish in a night, he would not take that many in an entire season now.

Then there is the halibut, of which a few years ago a great many were caught in the sound, but now it is a very rare occurrence to catch one. Fishermen have to go into the Fuca Strait for them, and that is also where they get the most dogfish now.

These fish that I have mentioned are the principal ones we ever had in these waters. We have quite a number of smelt and several varieties of flounders, but they are very scarce now, and one cause of this is on account of the Chinese fishermen we had here a few years past, who salted and dried them for the Chinamen in this country. We have also a "perch," a very inferior fish, which brings forth its young alive the same as our dogfish. These "perch" also are rare. There are some sculpins, and a small fish called a minnow. Then there is the rock-cod, an excellent fish which is very scarce on the sound now, but ten years ago they were very abundant.

We have also a good many shrimps, but they are very small; also four distinct varieties of clams. Oysters are met with in a few parts of the sound, but in limited quantities and of very small size, the largest being about the size of a silver dollar. Cockles and mussels are found. The mussels are small and inferior, but at Cape Flattery, in Fuca Strait, there is a mussel about 6 inches long, very finely flavored, and of a different species from those on the sound. We have four kinds of crabs, and with one exception they are all small and inferior, but the large ones are of the same species as the crabs in California.

There have never been any laws here to protect the fish, with one exception. Thiswas a law to protect the spawning ground of the herring, which spawn near our fishing ground. It takes in a shore line of about 15 miles, but all the other spawning grounds are unprotected.

Everything—gurry, sawdust, and every description of filth and rubbish—is thrown into the water. The mill-owners have let the sawdust run into the sound ever since they built their mills; some only a part, but others all of it. I am living in a saw-mill town, and the mill-owners have thrown most of the sawdust into the water, and the consequence is that the bay has filled in about 10 feet since I came here.

There are many lakes adjacent to the sound with outlets into it. Three miles back from Seattle Bay there are three lakes: Washington, about 20 miles long and 3 to 4 miles wide; Union, 2 miles long and one mile wide; Green, 1½ miles each way. Ten miles back from Seattle is Samamish Lake, about 10 miles long and about two to three miles wide. All these lakes have deep water, and are good lakes to stock with all kinds of fresh-water fish. The only fish in them is a species of trout, very few in number, the largest of which are about a foot in length.

PORT MADISON, WASH., *June* 11, 1886.

82.—TWO SPECIES OF AMERICAN FISH IN THE AQUARIUM OF THE ROYAL ZOOLOGICAL SOCIETY AT AMSTERDAM.*

In the Netherlands slow but sure progress is being made both in artificial fish-culture and the matter of transporting living fish from one country to another. Experiments have recently been made in transporting such fish for a considerable distance; and these experiments have proved entirely successful. The aquarium of the Royal Zoological Society at Amsterdam can in this respect chronicle results which must be called entirely satisfactory. Not only have different kinds of fresh-water fish been brought to the aquarium from Germany in perfectly sound condition, but also several kinds of foreign fish have been raised in our aquarium and brought to a condition of complete sexual maturity. Thus the *Idus melanotus* var. *miniatus*, a beautifully colored variety of the *Idus melanotus* found in our rivers, which is found in large numbers in the ponds of Dinkelsbühl in Bavaria, has spawned in a basin of our aquarium, a circumstance which has thus far not occurred in any other aquarium. At present ten of these fish, hatched and raised in our aquarium, are in the ponds of Mr. J. Noordhook Hegt's fish-cultural establishment at Apeldoorn, and have there likewise propagated their species. We desire, however, to call special attention to the fact that two species of American fish have been successfully transported across the ocean and placed in the Amsterdam aquarium. These two species of fish—namely, the American catfish and the American black bass—will doubtless stock many of our waters which at present contain scarcely any fish.

The American catfish (*Amiurus nebulosus* or *catus*) belongs to the *Silurus* family, and is therefore related to our *Silurus glanis*, the only variety of this fish found in Europe. This American catfish is originally found in the Schuylkill, the Delaware, the Hudson, and the large lakes of North America, but has also been transplanted to the Sacramento River, in California. The catfish is a good article of food. Owing to the transplanting of these fish to the Sacramento River large quantities are now brought into the San Francisco market, where they have become sought after. The question has been asked whether it would be desirable to acclimatize the catfish in Europe, especially as it has been sufficiently proved in America that the catfish cannot be called a predaceous fish in the full sense of the term, but lives both on animal and vegetable food.

*"*Twee Amerikaansche vischsoorten in het Aquarium van het Koninklijk Zoölogisch Genootschap 'Natura Artis Magistra' te Amsterdam.*" From the *Orgaan der Vereeniging to' Bevordering der Zoetwatervisscherij in Nederland* [Journal of the Society for the Promotion of the Fresh-water Fisheries in the Netherlands], Vol. I. Nos. 1 and 2, Amsterdam, December 4, 1885. Translated from the Dutch by HERMAN JACOBSON.

The first practical attempt in this direction was made in Belgium. Mr. Thomas Wilson, United States consul at Ghent, first suggested placing catfish in the Scheldt, a river which, owing to the large number of factories on its banks, does not contain many fish. It was presumed that the catfish would be particularly adapted to the River Scheldt, because it had been sufficiently proved in America that this fish is not much affected by the refuse from factories. After consulting with Prof. Spencer F. Baird, one hundred young catfish arrived at Antwerp in November, 1884. By the advice of Professor Baird, these young catfish were not immediately placed in the river, but first in the large basins of the aquarium. It is only after these fish have reached maturity in the aquarium and have spawned there that the young generation should be transferred to the river. This was done; and the young catfish received from America have provisionally been placed partly in a small pond in the Botanical Garden at Ghent, and partly in the Victoria-Regia basin in the same garden. The selection of the last-mentioned place we do not consider fortunate, as the temperature of the water in this basin is certainly much too high for these fish. At present there are in the Amsterdam aquarium 45 catfish brought direct from New York, and placed in a special basin with the hope that they will reach maturity and propagate their species. At present these fish measure from 4 to 6 inches in length.

As regards the mode of life, habits, and propagation of these fish, the following is known from the observations of Mr. John A. Ryder.* During winter the catfish lives at the bottom of the water, and prefers a clayey soil, in which it almost buries itself. During the first fine days in February some of these fish make their appearance, and in May they may be observed in rivers and lakes in large numbers. They prefer water which is muddy and does not have much of a current. No diseases or parasites have been noticed in the catfish. Their only enemies are bass, muskrats, and turtles. Mr. Ryder placed a male and a female separately in a basin of the Washington aquarium. The female laid about 2,000 eggs in a shapeless heap, and left them immediately after they had been laid. The male, however, acted very differently, and after the eggs had been impregnated, did not leave them for a moment, and by a regular movement of the pectoral fins caused a continual current of fresh water to pass through the mass of eggs. After a week the young fish slipped out of the eggs. On the thirteenth day after they had been hatched, the umbilical sac had disappeared, so that two days later the young fish eagerly took the food offered them, consisting of small pieces of liver. It is very remarkable that the eight feelers round the mouth begin to develop on the thirteenth day after the fish are hatched, at which time also the last traces of the umbilical sac have disappeared.

* See F. C. Bulletin for 1883, p. 225.

The black bass (*Micropterus salmoides*) belongs to the bass family, and is common in North America, especially in the Saint Lawrence River and the Mississippi. American ichthyologists distinguish two varieties, namely, the large-mouthed bass (*Micropterus salmoides*) and the small-mouthed bass (*M. dolomiei*). Both kinds are valued very highly for food, and fetch a good price in the market. They flourish best in broad flowing waters having considerable depth and not too low a temperature. In the northern part of North America, in the large lakes, they reach a weight of 4 to 8 pounds, and in the South a weight of 12 to 14 pounds. They prefer a rocky or pebbly bottom of rivers which have a strong current, but are also found in shallow lakes or ponds where there is but little current. They prefer to spawn on a gravelly or sandy bottom, where, by a strong movement of the fins, they make a sort of nest. Both the male and the female keep watch over the eggs and the young fish. The spawning season lasts from March till the middle of July, and varies a little according to the higher or lower temperature of the water. The eggs are hatched in 7 to 14 days, and the young bass remain in the nest from 2 to 7 days. Several attempts have already been made to acclimatize these fish in Europe; and both in England and in Germany these attempts have been successful. Max von dem Borne deserves great credit for having first introduced this fish in Europe; and next to him should be mentioned Mr. G. Eckardt, jr., of Lübbinchen, in Prussia, who took care of the fish during their transportation from New York to Bremen. But more than this, Max von dem Borne has succeeded in having three black bass spawn in his ponds. Several thousand young bass have by this famous fish-culturist been placed in a special pond, where they are fed with small crustaceans (*Daphnia*, *Cyclops*, &c.). Thus not only the transportation of these fish from America to Germany but also their propagation in German waters has been entirely successful.

The Amsterdam aquarium at present possesses four fine specimens of black bass, which grow well, and will, in all probability, reach sexual maturity. We owe a debt of gratitude to Prof. Spencer F. Baird, of Washington, and Mr. E. G. Blackford, of New York, and also to the captain of the steamship Edam, Mr. J. H. Taat, for the great care he took of the fish during the voyage from New York to Amsterdam; as to these gentlemen it is mainly owing that the experiment has proved successful. It will be of great importance to fish-culture in the Netherlands if the experiments made in the Amsterdam aquarium to propagate the American bass are crowned with success. Many of our rivers and lakes which at present contain hardly any fish could be advantageously stocked with American black bass.

63.—NEW ENGLAND FISHERIES IN JUNE, 1886.

By W. A. WILCOX.

During this month about the same number of vessels have been engaged in the fisheries as in June, 1885. Owing to the scarcity of mackerel, more vessels have followed cod and other ground fishing, and not so many have engaged in catching mackerel.

The receipts at Gloucester, which may be taken as a basis for the catch by the entire New England fleet, show a large falling off from the corresponding month of last year. Codfish show a decrease of 3,161,200 pounds. Receipts from all the fishing banks show a loss, but mostly from George's and Brown's.

Halibut have been very scarce on the Grand Banks, also on Western Bank, vessels having returned with less than half fares. In the deep water between George's and Brown's fish have been abundant, and good fares were secured, at times arriving in such abundance as to overstock the market, prices dropping as low as 3 cents a pound. The aggregate receipts of halibut vary but little from those of June, 1885. The vessels that went to Iceland for halibut have all been reported as arriving on the fishing grounds, and the prospect was favorable for their securing full fares. Schooner Mist was nineteen days on the way from Gloucester to Iceland, and the schooner Mystery was only fifteen days. The past winter was spoken of by the natives as very severe.

Weirs along the New England coast have had a light and unprofitable catch of numerous varieties, consisting of herring, squid, mackerel, and ground fish; enough to supply all demands for bait, with only a small amount for the market. At Monomoy Point, south of Cape Cod, the weirs were taken up the first of the month, the catch having been the smallest for years, which is thought to have been caused by the pollution of the water by a guano factory near by.

Mackerel have not been seen in any abundance since early in the spring. The fleet have constantly sailed all over the usual fishing grounds from Long Island Sound to the Bay of Fundy, Nova Scotia shore, and Gulf of Saint Lawrence, without finding any body of mackerel. The first mackerel reported caught at Chaleurs Bay were taken in traps on June 9, and a few barrels were taken off Prince Edward Island on June 14. The total amount of salt mackerel landed during the month by the entire New England fleet was 2,445 barrels, against 6,626 barrels in June, 1885, and was caught mostly in the vicinity of Roseway Bank.

On June 20 bonitos were seen in large quantities 50 miles south of Block Island. On the same date white water was, for the first time in several years, seen on Middle Bank. Squid have been very plentiful on the fishing banks as well as close in shore.

Menhaden have been scarce. The fleet engaged in their catch often cruised for a week or more without seeing any fish. A few scattering fish taken from the weirs are all the menhaden seen north of Cape Cod.

Whales have been numerous off the New England coast. Three steamers are engaged in taking them, being quite successful, although many that are shot and sink in deep water are not recovered.

Shad were schooling the last of the month in unusual abundance off Seguin and Small Point, Maine. Five hundred barrels were taken in purse-seines by the mackerel vessels and 200 barrels by smaller vessels that fished near shore. The shad were of good size and quality, one-third No. 1 balance mess, and sold at Portland for $4\frac{5}{8}$ and $8 a barrel.

On June 9 the new schooner Grampus, of the U. S. Fish Commission fleet, arrived at Gloucester. This vessel, designed by and built under the personal supervision of her commander, Capt. J. W. Collins, is of interest as a departure from the prevailing and almost universal style of a New England fishing vessel. She is $83\frac{30}{100}$ tonnage, and by experts is pronounced not only a fine-looking vessel but one that from her increased depth and model gives promise of much greater safety in rough weather, while at the same time she is expected to be a fast sailer. The Grampus is admirably fitted up for the practical and scientific work for which she is intended.

The Gloucester fishing-fleet enrolled and under license on the last day of June was: Under 20 tons each, 54 sail, with a tonnage of 609.25; over 20 tons each, 384 sail, with a tonnage of 26,448.71; making the total tonnage of the fleet 27,057.96.

The demand for all kinds of fish, both domestic and foreign, has continued depressed and far below the average. Although the receipts show a large decrease from those of one year ago, the market has at all times been well and amply supplied at prices lower than for many years. The extreme low prices do not seem to stimulate an increased consumption.

The following is the position of the New England fishing fleet during the last week of June:

Position.	Object.	No. of sail.
Grand Banks, lat. 44° to 46°, long. 52° to 54°	Codfish	175
Grand Banks, lat. 44° to 45°, long. 49° to 51°	Halibut	40
Western Bank, lat. 44° to 45°, long. 60° to 61°	...do	30
George's and Brown's Banks, lat. 41° to 43°, long. 66° to 68°	Cod and halibut	230
From Block Island to Gulf of Saint Lawrence	Mackerel	250
Off eastern coast of New England	Ground fish	300
On trips to Iceland or Greenland	Halibut	8
Total		1,033

In addition to the above, three steamers were engaged in taking whales off the New England shore; and one steamer was fishing for mackerel off this shore.

The British steamers Carmona and Concordia arrived at Montreal on June 21, being the first vessels through the Strait of Belle Isle this season. They report many fields of small broken ice and a great number of large icebergs, extending as far east as 110 miles from the strait.

Receipts of fish at Gloucester, Mass., in June, 1886.

From—	Fares.	Salt codfish.	Fresh halibut.	Salt hake.	Salt pollock and salt cusk.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
George's Bank	142	2,880,000	342,650	1,000	
Brown's Bank	8	253,000	22,800		
Grand Banks	29		657,000		
Cashe's Bank	5	165,000	400	42,000	
Cape North	1	8,000			
La Have Bank	1		35,000		
Nova Scotia, Cape shore	3	125,000			
Western Bank	14	1,112,000	36,000	10,000	
Bay of Fundy	5	149,000	3,300	45,000	
Banquereau	1	10,000	18,000		
New England shore*	28	380,000	72,000		†414,000
Mackereling‡	23				
Total, June, 1886	260	5,082,000	1,187,150	98,000	†414,000
Total, June, 1885	399	8,243,200	1,204,000	113,800	§212,500

* In addition to the fares above stated, 2,000 pounds of salt haddock were brought in.
† Of this amount, 34,000 pounds were salt cusk.
‡ Yielding 2,445 barrels of salt mackerel, the amount in June, 1885, having been 6,626 barrels.
§ Of this amount, 103,500 pounds were salt cusk.

GLOUCESTER, MASS., *July* 15, 1886.

64.—REPORT UPON THE SHAD AND HERRING FISHERIES OF THE POTOMAC RIVER FOR 1886.

By GWYNN HARRIS.

Number of shad landed at Washington from March 19, 1886, to June 10, 1886, inclusive	180,175
Number of shad landed at Alexandria, Va	34,847
Number of shad shipped by steamer Sue to Baltimore	48,000
Number of shad shipped by steamer W. W. Corcoran to Baltimore	5,600
Number of shad sold on the different shores	6,800
Total	275,422

Number of herring landed at Washington from March 13, 1886, to June 10, 1886, inclusive	7,315,473
Number of herring landed at Alexandria, Va	3,979,324
Number of herring shipped by steamer Sue to Baltimore	850,000
Number of herring sold on the shores and from trap-nets	1,400,000
Total	13,544,797

65.—CARP IN FRANCE.*

The carp is generally well known. It has a strongly-curving back of an olive or bluish color, yellowish below, and with a whitish belly. The spines forming the first ray of the dorsal and the anal fins are strong and toothed. It has pharyngeal teeth, flat and grooved at the crown. There is a lateral line of 48 black points; the dorsal fin has 21, 22, or 24 rays; anal, 8 or 9; each ventral, 9; and there are 3 toothed rays to the dorsal and the anal fins. The caudal and the ventral fins are of a violet color; the anal fin is of a reddish-brown; and the gill-covers are glossy and without notches. There are 4 barbels, 2 of which are at the angles of the jaw. Its scales are large and hard. The bony parts of the anatomy of this fish are very numerous, and 4,386 pieces have been counted. The head is strong, large, and blunt, and the eyes are small.

The carp comes from the central and southern parts of Europe, and has been acclimatized almost everywhere. [It seems to have come originally from Central Asia, whence it was introduced into Europe as a food-fish.] It thrives in the quiet waters of France, where it sometimes attains the length of nearly 4 feet. It grows readily in ponds, and is of a good flavor. Clear and gently-flowing waters are suitable for it; and at the same time it finds in these waters some qualities which escape our notice, since it remains in certain portions of a stream or river and is found only in these portions. The sensibility of the carp on this point is so great that those which have been raised and set free in other parts of these streams go to rejoin the other carp in these places and do not restock the whole length of the watercourse. Carp multiply rapidly in ponds; the muddy water, however, of these bodies of water is apt to give a muddy taste to their flesh. It is easy to rid the fish of this muddy flavor elsewhere by putting them for at least eight days into clear running water.

When the carp is about to spawn, it leaves the large watercourses to seek more quiet places, and is not stopped on its way by waterfalls of 6 feet in height, which it ascends with as much dexterity and perseverance as trout. In spawning it rubs against weeds in order to aid in the ejection of its eggs; and often it is almost entirely out of the water, especially during a pleasant spring and under the rays of a warming sun. At spawning time the flesh is soft and flabby.

The young carp are much exposed to the teeth of their enemies, and an immense number become the food of fish, birds, and animals; but after they are three years old they have little to fear from pikes and others. Carp have a very long life. Those that we call salmon carp have

*From the *Moniteur de la Pisciculture, &c.*, Paris, November 28, 1885. Translated by H. P. JERRELL.

red flesh and are delicious eating. The growth of this fish in a place where it gets good food is rapid, for in the period of seven years it passes from a weight of 8 grams to 8 kilograms [$\frac{2}{7}$ ounce to 17$\frac{2}{3}$ pounds, about], increasing a thousand-fold, but after reaching this size it increases much more slowly. We often see very large specimens, with the head much rounded in front and with blunt noses. A race with large scales has been produced, some individuals of which have the skin bare in places; and some are entirely scaleless. These varieties are called Queen Carp, Mirror Carp, Leather Carp, &c.

The carp is not very voracious, but it lives upon spawn, insects, and many vegetable and animal substances that it finds in the mud. When the carp is lean its head seems to be very large in comparison with its body.

The small carp are not good eating, but the large ones are plump and their flesh is firm and delicate when they are caught in living water. The Rhine carp and those of Montreuil-sur-Mer are highly esteemed, while those of the Lot River pass as excellent. In the Saône River these fish are of very good quality, while the rapid and clear waters of the Moselle and the Loire furnish carp that are little sought.

M. Bienne, of the fish-cultural establishment at Hüningen, found on December 15, in the Lake of Constance, carp whose eggs and milt were fully matured. Can this indicate that this fish spawns twice a year?

PARIS, *November* 28, 1885.

66.—THE PREPARATION AND COOKING OF CARP.

By ALFRED DOLGE.

[From a letter to Prof. S. F. Baird.]

In very many cases the carp is taken from muddy, half stagnant water of a high temperature, and is immediately killed, and then cooked after a fashion. Such a fish is utterly unfit to eat, and is apt to make the partakers of the meal sick. Now imagine a carp taken out of such water and transported to market, or even not eaten until the next day. Yet this is what is very often done, and the outcome of it is the general verdict that carp is worthless as a table fish. In Germany the professional fisherman does not bring pond carp for sale to market until they have been in big boxes for from two to three weeks in running river water, so as to be rid of the muddy taste which they acquire in ponds. Any clear running water will do it. Then they are put into big tubs, brought to market in good shape, swimming around, and the purchaser picks out his fish and brings it home alive, where it is killed when wanted for the table. Such a fish when properly cooked is really a delicacy. I usually have a great many visitors at the time when I

begin to fish my ponds, and they are all astonished at the fine qualities of the carp. Even those who had eaten, or tried to eat, them before, and were disgusted, become enthusiastic. The difference is owing to the treatment the fish receive, and to some extent, of course, to the cooking. Thinking they may be of interest, I add here some of the methods according to which my carp are cooked:

CARP IN BEER, OR POLISH CARP.—Bleed a large live carp at the throat, catch the blood in vinegar; scale, wash and clean inside. Cut into halves, and these into large pieces. Take a deep pot, cover the bottom with sliced onions, some mixed ground spice, and a few cloves. Put the split head and pieces with back fins in first, the fins to point toward the bottom. Now take a piece of rye bread or Boston brown bread or roasted white bread without rind, some salt, one small piece of sugar, some slices of lemon, and some bay leaves. Put all on top of the fish. Pour in a little vinegar and white beer and lager beer (or new ale and porter), each in half parts, until the liquor covers the fish fully. Have a good strong fire and begin to boil, taking care, by shaking the pot once in a while, that the fish does not burn on the bottom. When nearly done take for four pounds of fish about $\frac{1}{4}$ pound of butter, roast it brown with a spoonful of flour, mix up with the blood and vinegar, and put on the fish. Taste the sauce to see if it is sufficiently sweet, sour, and salty, three qualities which it must have, and cook the fish until done. Serve with potatoes in their skins.

BLUE-BOILED CARP.—Be careful not to remove any scales or coating. Split the carp along the back, clean inside, and pour cold or boiling vinegar over it until covered. When the outside has turned nicely blue, put it on the stove with cold water, into which put salt, onions, one or two bay leaves, and some cloves. Take the carp from the fire as soon as it boils up well, and set it aside in a warm place. Serve with either melted butter mixed with parsley chopped, or ground horse-radish mixed with vinegar, sugar, and salt.

BAKED CARP.—Cut the carp into pieces or halves. Clean well, but leave the scales on. Cover with salt, lemon juice, sliced onions, pepper, and parsley. After it has lain thus one hour, dry the carp, roll it in eggs and cracker dust, and bake slowly in butter. Serve with lemon and potatoes boiled or baked.

PICKLED CARP.—Clean the carp outside and in; split it the whole length; cut it in pieces; wash, and cook it in water with salt, spice, onions, and a few bay leaves. After it is cooked let it get cold in the pot. When cold remove and put it into a drainer or sieve to dry off. Now pick to pieces, taking out all bones; mix with sauce rémolade or a sauce consisting of Worcestershire sauce, vinegar, sugar, salt, ground black pepper, olive oil, and yellow mustard, according to taste; all well beaten and mixed, olive oil and vinegar being in preponderance. Serve with capers, olives, and mixed pickles.

DOLGEVILLE, N. Y., *September* 17, 1886.

67.—THE AMERICAN BROOK TROUT RECOMMENDED FOR SWISS WATERS.*

By HERMANN GOLL.

Thanks to the efforts of the German Fishery Association, it has become possible to acclimatize in European waters several kinds of American fish, such as the California salmon, the valuable American salmon trout (*Seelachs*, lake salmon), the whitefish, and the American brook trout (*Salmo fontinalis* Mitch.).† Von Claparède in the spring of 1883 sent a considerable number of the eggs of this fish to Switzerland; 4,000 were sent to the canton of Vaud, and were hatched in the small fish-cultural establishment of Roveray, near Allaman. Unfortunately the hatching troughs were one day flooded by violent showers, and in consequence a large number of the young fish which had been hatched were carried away. Of the small remnant, about 300 were placed in a pond near St. Prex, and 100 in a small pond in my garden. This pond has a long oval shape, and measures 4 meters in length, 2 in breadth, and almost $\frac{1}{2}$ meter in depth; its walls are of cement. It is fed from my house reservoir, containing good drinking water with but little lime in it, which comes from the Pierre-Ozaire. The temperature of this water is 6.5 to 7° C. [about 44° Fahr.]; in summer it exceptionally rises to 12° [53.6° F.]. As hidingplaces for the little fish, my pond has some small caverns of tufa, forming a sort of subterranean passage. The bottom is covered with mud from the lake, in which there is a dense growth of *Elodea canadensis* and *Potamogeton densus*.

The young brook trout, which had been placed in the pond, in the beginning persistently hid themselves, so that I began to doubt whether they were really there. Some articles of food which were thrown into the pond were not touched, and I therefore stopped throwing in any food. After about three months some of the little fish occasionally made their appearance, having grown considerably. When placed in the pond, they measured 18 to 20 millimeters [$\frac{3}{4}$ inch] in length, while now they measured 5 to 6 centimeters [$2\frac{1}{4}$ inches]. I now had frequent opportunities to see of what their food principally consisted. My aquatic plants were covered with great masses of *Gammarus roeselii;* and my little fish eagerly chased small specimens of this crustacean.

In September, 1883, my fish measured 9 centimeters [$3\frac{1}{2}$ inches] in length. To accelerate their growth, I placed in the pond a number of small *Phoxinus lævis*, and several small specimens of *Cobitis barbatula*. These fish all disappeared, and I presumed that the trout had devoured

* "*Der amerikanische Bach-Röthel.*" Translated from the German by HERMAN JACOBSON.

† In January, 1883, 25,000 brook-trout eggs were sent by the United States Fish Commission to the Deutsche Fischerei-Verein. See F. C. Report for 1883, p. xli.

them. As I had no more of these fish to give them, I commenced to throw earthworms into the pond. Two to three times a week I had a grand feeding-time, and convinced myself that the new food was eagerly taken by the trout. With the same relish they devoured small grasshoppers, gnats, caterpillars, &c. I am now able to explain how it came that I occasionally found early in the morning one of my little fish outside the pond; it had too eagerly chased insects flying over the water and leaped out of the water upon the bank.

When the cold season set in, I made an attempt to feed my fish with meat chopped fine, but it invariably remained on the bottom untouched. Possibly this was caused by the diminished voracity of the fish, resulting from the winter season.

In January, 1884, I again noticed the *Phoxinus lævis*. Nearly all of them returned; and I must presume that the brook trout does not chase fish, as both kinds of fish live, up to date, together in perfect peace and harmony. The *Phoxinus lævis* had grown considerably, and I began to throw little pieces of soaked bread to them. After a few hours these had disappeared; and I think I have occasionally seen the trout snap after this food.

In the summer of 1885 most of my trout had reached a length of 20 to 25 centimeters [about 9 inches]. About one-third of them had not grown so long; these were the ones which always came too late, when I threw food in the pond, and had to satisfy their hunger with some of the bread. Similar observations were made relative to the little fish which had been placed in the pond near St. Prex; only they remained smaller, because no food was thrown to them.

On the whole, I am very well satisfied with the growth of these fish. As, moreover, they are easily satisfied (my pond was often supplied with very little water, and was frequently polluted by rain-water) and manage to live on all sorts of animalcules, I think I can recommend them for many of our waters. In clear brooks, which contain a good many *Gammarus roeselii* and larvæ of insects, the American fish is found to be less predaceous than our brook trout; and as to its growth and the delicacy of its flavor, it is fully the equal of our trout. In my opinion, and after repeated trials, the American brook trout is in every way the equal of the char from the Lake of Zug, which enjoys a high reputation as a table fish.

The American brook trout is a genuine "Saibling," and can therefore justly be classed with the genus *Salmo*. We find in it the *os romer* in the upper jaw, only with teeth in front, just as in the Zug char. Its body is thick-set, the snout short, and the color something like that of our char. The back and sides have a dark-green ground color; the belly has a beautiful rosy color, with a slight admixture of orange. On the sides there are numerous very bright red, white, and yellowish-white spots. The brownish-yellow dorsal fin has some intensely black streaks. The ventral, pectoral, and anal fins have a deep red color, and have a

shining white front edge. The caudal fin, which is cut off straight, is of a brown-red color. During the spawning season these colors become brighter, and at that season the brook trout compares favorably with some of the most beautiful of the finny tribe. In Zurich very successful experiments have been made with the *Salmo fontinalis*. Four of these fish, which were raised in the fish-cultural establishment of Dachsen, produced last autumn about 200 eggs, and from these there have now been hatched about 60 or 70 lively and healthy young fish.

We take occasion to express once more our hearty thanks to the German Fishery Association for its valuable present. Let us hope that there is a great future in store for this new citizen of Switzerland, which has come to us from far-off America.

ZURICH, SWITZERLAND, 1886.

68.—HABITS OF WHITING OR FROST-FISH (MERLUCIUS BILINEARIS, Mitch.).

By WILLARD NYE, Jr.

These fish appear in our shallow waters during October or November,* according as the season is early or late. They come in to feed from sunset to sunrise, and are then seen, often where the water is not over two inches deep. During the daytime they are never seen alive near the shore, nor have I ever seen any at or near the surface in deep water.

They feed on the silver-sides or friar, which abounds here at this season, and which, being chilled, is easily caught. The frost-fish do not come in schools proper, but scattered along shore—from a few to many feet apart, and headed in all directions, moving slowly along—generally near the bottom, and now and then rising to seize a friar, which they do by shooting ahead two or three feet quite rapidly; if successful, they then sink to the bottom and slowly swallow the small fish.

Many frost-fish are speared by men and boys wading along shore with lanterns. Quantities are caught in the fish-traps, and if the night happens to be very frosty hundreds are left by the falling tide, this last more frequently happening on the outer beaches, where there is a little swash along shore. In size they vary generally from two or three ounces to one pound; those on the outside beaches are the largest, while inside the mouths of rivers they are small. When seen in the water at night they appear of a dull reddish color. Early in October, while fishing for codfish in five or six fathoms, I have caught frost-fish that would weigh two or three pounds; and in the trawl on the Albatross I have seen specimens that would weigh as much as eight pounds.

NEW BEDFORD, MASS., *August* 20, 1886.

---

* For a brief note on their appearance, see F. C. Bulletin for 1886, p. 137.

Vol. VI, No. 14. Washington, D. C. Oct. 1, 1886.

69.—THE TENCH RECOMMENDED FOR CULTIVATION IN SWEDEN.

By FILIP TRYBOM.

In Sweden we have a fish closely related to the carp, which at least so far north as Dalarne and Helsingland could be planted to great advantage in many lakes, streams, ponds, and other small waters with a loose bottom, and with banks at least partially covered with vegetation. Professor Wittmack says, "Besides the eel there is hardly another fish so suitable for stocking marshy waters as the tench;" and in making this statement he has reference to Germany, where it is thought that the carp is the best fish for this purpose. In the carp ponds tench are often kept with carp, as the tench is satisfied with food which the carp does not care for, or could not easily get at. In Germany it is said that the tench does not grow as rapidly as the carp. In Sweden this will probably be different. There is every reason to suppose that the tench, being indigenous in more northerly latitudes, will flourish and grow in colder water than the carp can stand, and will therefore have a longer annual period of growth. Cold winters and thick ice do not disturb the tench, which has a great capacity for burrowing in the mud and lying in a state of torpor. In Germany it reaches a weight of 1½ kilograms [a little over 3 pounds] in the third year, and when six or seven years old is said to reach a weight of 3 to 4 kilograms [6½ to 8¾ pounds]. In Sweden, when in suitable waters, like those in the northern part of the province of Småland, it reaches a weight of 5 or more pounds. I do not know how fast it grows in Sweden in a free state, for, to my knowledge, only very imperfect observations have been taken regarding this matter. Very few of our fish can so well stand a long transportation as the tench. It can therefore easily be transferred to waters at a great distance from its home. Although it is much sought after by the pike, it can nevertheless be planted in waters where pike and perch are found, as it knows well how to hide in the mud and in dense growths of aquatic plants. As an instance of the successful planting of tench, it may be mentioned that in a small lake in the northern part of the Kalmar district, in 1871, 46 tench, weighing from ¼ to ½ pound, were planted. Three years later the largest of these had reached a weight of 4 pounds. After 15 years, and probably sooner, many tench were caught in this lake, and they had spread to another lake in the neighborhood. In another small lake, not far from the above-mentioned, 20 tench were planted, measuring 5 to 6 inches in length. After 12 or 15 years had passed, there were excellent tench fisheries in this lake, many of the fish weighing from 4 to 5 pounds. In

these small lakes there are also the bream, crucian, roach, bleak, pike, perch, eel, and some other kinds of fish.

In many parts of Sweden the tench is considered as a fish of little value, and as not being a wholesome article of food, and consequently it does not sell at a good price. In Germany, where this fish is better known, it is appreciated more. It is stated that it often sells at as high a price as the carp, but generally tench costs about two-thirds of the price of carp. The tench has frequently a more pronounced muddy or peaty flavor than the carp, but if kept in clear, running water for five or six days it will almost entirely lose this flavor.

70.—NEW ENGLAND FISHERIES IN JULY, 1886.

By W. A. WILCOX.

With the exception of mackerel the receipts show few changes in quantity from those of the corresponding month of last year. At Gloucester the same number of fares of cod and other ground fish have been landed—277 cargoes each year. Of mackerel 30 fares arrived from the Gulf of Saint Lawrence and 7 small broken fares from off the New England coast, against 116 fares during July, 1885, making the aggregate fares 307 in July, 1886, and 393 in July, 1885.

Codfish of good size and quality were abundant. A number of vessels have returned to home ports from their second trips with full fares, caught on Banquereau, Western Bank, and Grand Banks. Nearer home the catches on George's and Brown's Banks have been good, at the close of the month falling off on the former and increasing on the latter. The July catch by the Gloucester fleet of the past two seasons, on these two banks, is of interest as showing the fluctuation in the catch from one bank to the other:

Codfish landed at Gloucester during July.

	1885.	1886.
	Pounds.	*Pounds.*
From George's Bank	1,671,000	4,585,000
From Brown's Bank	3,067,000	214,000
Total	4,738,000	4,799,000

The fish from George's usually are given the preference, as being of superior quality to those from any other locality.

Halibut have continued scarce, vessels arriving mostly with small fares. A few vessels fishing between George's and Brown's have brought in larger fares than those from the Grand and other banks. The total receipts for the month show a falling off of 170,350 pounds from those of July, 1885.

Hake, haddock, and other ground fish have been fairly abundant on the eastern fishing grounds, and an average catch is reported.

Bluefish have been less plentiful than for a number of years. Only occasionally has any amount been taken, and much of the time vessels have returned empty.

Swordfish have been numerous, the catch being mostly made in the vicinity of Block Island. The price has been as low as 3 cents a pound.

Mackerel, in large bodies, seem to have abandoned their usual resorts this year. All the season, since their disappearance south of Long Island, the fishermen have sought them all along the usual fishing grounds off the New England coast as far as the Bay of Fundy, on George's and Brown's Banks, and in the Gulf of Saint Lawrence. After weeks of constant search vessels have been obliged to return to home ports with very few fish, if any. They would at once refit and start again. During the first of the month 125 sail were cruising off the New England coast—50 sail in the vicinity of Block Island and 75 sail in the Gulf of Saint Lawrence. Small mackerel were found quite abundant, and occasionally small schools of large fish were taken off the eastern coast and about Block Island. In the Gulf of Saint Lawrence the search was equally unsuccessful up to the middle of the month, when the fish appeared in considerable abundance on Bradelle and Orphan Banks, to the north of Prince Edward Island. The fish were mostly taken from 10 to 20 miles from shore, and were of good size and fair quality.

No improvement taking place off the United States shores, the fleet slowly and reluctantly went from the eastern shore to North Bay, at the close of the month 150 sail of the New England fleet of seiners being in those waters. A few sail were hauled up temporarily, and 100 vessels remained scattered all over the fishing grounds off the New England coast. The oldest fishermen report that never have they seen a season that would compare with this for the scarcity of mackerel.

The native fishermen of the Provinces have been equally unfortunate. The few vessels they had engaged in seining could not find mackerel schooling, while the boat fishermen using hand-lines complained that mackerel when found would not take the hook, and consequently their catch was also insignificant.

Bait has been plentiful all the month, the weirs of Cape Cod at nearly all times having an abundance of squid and small mackerel. Along the coast of Maine herring have been in great abundance; at several points for days the weirs and traps would be full and closed, waiting for buyers. Squid have been very abundant along the New England coast; also at times on the leading fishing banks.

Prices of all kinds of salt-water fish have ruled very low, in many cases being below the cost of production, and lower than for years, if ever before. The season thus far has certainly been a most discouraging one for all engaged, yet fishing is persistently and hopefully followed, in hopes of a better future.

Receipts of fish at Gloucester, Mass., in July, 1886.

From—	Fares.	Salt codfish.	Fresh halibut.	Salt hake.	Salt haddock.	Salt pollock.	Salt cusk.	Fresh swordfish.	Salt mackerel.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Barrels.*
George's Bank	184	4, 585, 000	193, 600	4, 000	4, 000	....	10, 000	....	....
Brown's Bank	6	214, 000	1, 600	....	....	....	....	....	....
Grand Banks	35	1, 925, 500	714, 300	....	....	....	....	....	....
Banquereau	7	287, 000	123, 000	....	....	....	....	....	....
Nova Scotia, Cape shore	4	140, 000	....	....	....	....	....	....	....
Off Labrador	1	2, 000	27, 000	....	....	....	....	....	....
Flemish Cap	2	430, 000	35, 000	....	....	....	....	....	....
Western Bank	3	335, 000	1, 400	....	....	....	....	....	....
New England shore	35	385, 000	....	64, 000	22, 000	35, 000	9, 000	6, 630	164
North Bay	30	....	....	....	....	....	....	....	12, 190
From small boats, shore-fishing	....	26, 000	....	20, 000	....	....	....	....	....
Total in July, 1886	307	8, 329, 500	1, 095, 900	88, 000	26, 000	35, 000	19, 000	6, 630	12, 354
Total in July, 1885	393	8, 220, 500	1, 266, 250	77, 500	....	3, 000	17, 500	783	*39, 637

Additional during July, 1886, 22,000 boxes of smoked herring, from Maine.

*Also, in July, 1885, there were 563 barrels of fresh mackerel.

The importations of fish for the year ending July 1, 1886, being the first full year since the termination of the Washington treaty and the return to a duty on fish from the British Provinces, are as follows:

Kind of fish.	1885.	1886.
Free of duty.		
Fresh fish, salmon excepted .... pounds..	17, 913, 742	19, 732, 787
Fresh salmon .... do....	1, 336, 541	1, 422, 720
Cod and other dry fish .... do....	32, 399, 578	....
Herring, smoked .... do....	10, 558, 315	....
Herring, pickled .... barrels..	104, 742	....
Mackerel, pickled .... do....	91, 680	....
Salmon, pickled .... do....	5, 872	....
Subject to duty.		
Cod and other dry fish .... pounds..	....	14, 324, 080
Herring, smoked .... do....	....	5, 712, 725
Herring, pickled .... barrels..	49, 643	97, 922
Mackerel, pickled .... do....	....	50, 847
Salmon, pickled .... do....	....	4, 562

Value of all fish imported, including anchovies, sardines, and other canned fish.

	1885.	1886.
Free of duty	$3, 452, 497	$1, 076, 644
Dutiable	1, 353, 138	2, 535, 646
Total	4, 805, 635	3, 612, 290

GLOUCESTER, MASS., *August* 18, 1886.

71.—FISH-CULTURE IN NEW ZEALAND.

By WILLIAM SEED,
Secretary of the Marine Department.

[From the Annual Report of the Marine Department.]

OYSTERS.—Owing to the reckless way in which the rock-oyster fisheries have been worked it has been found necessary, in order to prevent their absolute destruction, to close the beds at Whangarei, the Hauraki Gulf, and the coast and harbors between Bream Head and a point just north of the Bay of Islands, for a period of three years. It is hoped that by the end of that time the beds will have recovered. It was reported that one of the main causes of the beds having been so nearly destroyed was that the oysters were frequently stripped from the rocks with spades, which reckless operation cleared away the small with the marketable oysters. In order to prevent this an order in council has been made providing that no spade or apparatus for taking rock-oysters shall be used of which the edge or blade shall exceed 2 inches in width. An order in council was also made under the provisions of "The fisheries encouragement act, 1885," prohibiting the exportation of rock-oysters from the colony. The great importance of conserving our oyster-beds, both rock and mud, cannot be more forcibly illustrated than by quoting from the report of the royal commission on the fisheries of Tasmania in 1883, which shows that whereas, in one of the best years, the number of oysters dredged from the principal native beds amounted to 22,350,000 (the value of which, at the present current prices, would be £93,125 [about $452,588], a sum which, it is stated, is more than the equivalent of the value of the exports of grain, hay, flour, and bran from Tasmania in the three years previous to the date of the report), the yield of the beds has been reduced by over fishing to not more than 100,000 per annum. The knowledge of this should be sufficient to induce the Government here so to regulate the taking of oysters as to prevent the productiveness of our beds from being arrested or destroyed from the same cause. The quantity of oysters exported from New Zealand, chiefly to Sydney and Melbourne, during the year ended the 31st of December last, amounted to 1,057,760 dozen rock-oysters, valued at £3,333 [$16,198], and 170,455 dozen mud-oysters, valued at £2,196 [$10,673].

SALT-WATER FISH.—The Department is at present collecting information on the habits, spawning season, &c., of the edible fish inhabiting New Zealand waters, with a view of adopting and enforcing a close season for some of the fish. I trust to be able by next year to report more fully hereon. A trawl has been ordered from England for use on board one of the Government steamers, for the purpose of ascertaining

what kinds of fish can be procured on the various parts of the coast, and the best seasons for taking them.

FRESH-WATER FISH.—A shipment of whitefish ova was received from America in February last, unfortunately in a putrid condition. These were forwarded through the courtesy of Prof. Spencer F. Baird, the U. S. Commissioner of Fish and Fisheries. A shipment of salmon ova was received by the steamer Ionic in March last, and was distributed among certain acclimatization societies. I am glad to say that this shipment turned out a success, in fact, the most successful, I believe, hitherto received in the Australian colonies. Some 200,000 eggs were shipped, but only eight of the nine boxes arrived in good condition, one having to be left out of the icehouse prepared for the ova, there being no room for it. Notwithstanding this, some healthy fry were hatched out. I note that in Tasmania their most successful shipment of salmon ova, received by the Yeoman in 1885, yielded 36,000 fry out of 150,000 ova shipped, or 24 per cent, while those by the Ionic yielded some 50 per cent of healthy fry. The importation of these eggs and the various steps that had to be taken in anticipation of, and after, their arrival in the colony were carried out under the immediate directions of the Hon. Sir Julius Vogel, the commissioner of trade and customs. The correspondence relating to the introduction of fish ova has been printed, and will be presented to Parliament as a separate paper.

I would submit, for consideration, whether the present practice of placing the young salmon fry in many different rivers is a judicious one. It would appear to be more desirable to put all the salmon fry hatched into one particular river, that river being selected, regardless of position and district, as being the best salmon river, on account of the temperature of water and other necessary conditions. When once salmon are established in one river it would be only a work of time to get them placed, at any rate, in most of the rivers in Middle Island [or South Island]. In support of this plan, I quote the following paragraph from the U. S. Commission of Fish and Fisheries Report for 1882, p. lviii, on the subject of the artificial propagation of fish: "Failures have resulted, in a large degree, from the limited scale on which the work has been carried out. If the expectancy of destruction in a given locality be estimated as representing one million young fish, and any number *less* than one million be introduced therein, it is easy to understand that there will be no result." This opinion appears to apply with singular force to New Zealand, where several of the acclimatization societies are eager to secure a share of the young salmon in order that they may be turned out in rivers in various parts of the colony, some of which are entirely unfitted for the salmon to thrive, or, perhaps, even to live in.

Now that the Government has taken in hand the importation of fish ova, I submit for consideration whether it would not be desirable, in the public interest, to make some inquiry as to the operations of acclimatization societies, especially in relation to pisciculture. So far as I can

make out, there are no less than twenty-one such societies in the colony. All that appears to be requisite for the establishment of a society is that a copy of its rules, signed by the chairman and countersigned by three members thereof, shall be deposited in the office of the colonial secretary. There is thus nothing to prevent any half-dozen persons from forming themselves into an acclimatization society in any district where no organization of that kind has already been constituted. It has, therefore, been the practice, at the instance of any one of these societies, to make and gazette regulations under "the Salmon and Trout act, 1867," for fishing in specified waters within the district in which such society operates. These regulations prescribe a fee, usually £1, for every fishing license. There is no specific authority in the act for imposing the fee; this seems to have been done under the provisions in the act quoted, which authorize the governor to make such regulations for certain specified purposes as seem expedient, and also "as to any other matter or thing which in any manner relates to the management and protection of salmon or trout in this colony, or to the fishing for or taking salmon or trout." In some districts considerable amounts must be collected from the public for such licenses, and, as the license fees are of the nature of a tax, I think it would be only reasonable in future to require that the accounts of societies which receive these fees should be published. I think it would also be reasonable for the Government in future to require any society which submits regulations for approval and publication to furnish, along with such regulations, a copy of its rules and a list of its members.

HATCHERIES.—I understand that seven fish hatcheries belonging to acclimatization societies are now in existence, namely, one each at Auckland, Wairarapa, Nelson, Christchurch, Dunedin, Wallacetown (Invercargill), and Queenstown, and one, belonging to a private individual, at Opawa, near Christchurch. Now that communication between different parts of the country has been so greatly facilitated by the extension of the railways, it is worthy of consideration whether better results with less expenditure of money could not be obtained by having two well-equipped establishments, one in North and one in Middle Island, whence the young fry could be easily distributed.

In making the above remarks I have no desire whatever to detract in the slightest degree from the credit that is due to many of the acclimatization societies, for undoubtedly they have rendered lasting and most valuable service to the colony in introducing and stocking our rivers with trout. This good work has been accomplished by the zeal, energy, and public spirit of the members of those societies, who have not only contributed largely from their private purses, but have, year after year, sedulously watched over the hatching of the ova, and afterwards undertaken long and toilsome journeys to distant lakes and rivers to liberate the young fish. My object has been to exhibit the question

in a purely economic light, and to suggest a course of action in regard to these societies which I am inclined to think would tend to establish them on a satisfactory footing and promote their well-being, as it would operate in the direction of preventing the undue increase of small, weak societies, and thus strengthen and widen the sphere of usefulness of the larger and older ones.

WELLINGTON, NEW ZEALAND, *June* 1, 1886.

72.—AN ACT RELATING TO THE IMPORTING AND LANDING OF MACKEREL CAUGHT DURING THE SPAWNING SEASON.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the period of five years from and after the first day of March, eighteen hundred and eighty-seven, no mackerel other than what is known as Spanish mackerel, caught between the first day of March and the first day of June, inclusive, of each year, shall be imported into the United States or landed upon its shores: *Provided, however*, That nothing in this act shall be held to apply to mackerel caught off-shore with hook and line, from open row-boats of less than twenty feet keel,* and landed in said boats.

SEC. 2. That section forty-three hundred and twenty-one of the Revised Statutes is amended, for the period of five years aforesaid, so as to read before the last sentence as follows: "This license does not grant the right to fish for mackerel, other than for what is known as Spanish mackerel, between the first day of March and the first day of June, inclusive, of this year." Or in lieu of the foregoing there shall be inserted so much of said period of time as may remain unexpired under this act.

SEC. 3. That the penalty for the violation or attempted violation of this act shall be forfeiture of license on the part of the vessel engaged in said violation, if a vessel of this country, and the forfeiture to the United States, according to law, of the mackerel imported or landed, or sought to be imported or landed.

SEC. 4. That all laws in conflict with this law are hereby repealed.

Passed the House of Representatives May 21, 1886.

On July 29, 1886, Mr. Thomas W. Palmer, from the Committee on Fisheries, submitted to the Senate the following report:

This bill is designed to prevent the taking of mackerel by seines and purse-nets between the first days of March and June of the five years succeeding its enactment. It is urged with practical unanimity by the vessel-owners and fishermen engaged in this industry, and is opposed only by commission dealers in fresh fish.

---

* Here the Senate Committee on Fisheries struck out the words "open row-boats of less than twenty feet keel," and inserted the word "boats" instead.

The testimony taken by the committee shows an alarming decrease in the better grades of mackerel suitable for salting as food. The average yearly catch in amount for the years from 1809 to 1872, inclusive, was 166,184 barrels. The average yearly catch from 1872, the time purse-nets came into general use, to 1885, inclusive, was 201,204 barrels. It will be seen that the average annual amount caught for the last thirteen years is only about 20 per cent greater than for the sixty-four years from 1809 to 1872, notwithstanding the improved appliances which should have insured a vast increase in the catch, stimulated as the business has been by a greatly increased demand from a rapidly increasing population and improved methods of distribution. Far more to be deprecated than the deficient catch has been the deterioration in quality, as shown by the decrease in percentage of No. 1s.

In 1865 No. 1 mackerel was 59 per cent of the whole catch; in 1866 it was 64 per cent; in 1867 it was 58 per cent; in 1868 it was 51 per cent; in 1869 it was 31 per cent; in 1870 it was 21 per cent; in 1871 it was 40 per cent; in 1872 it was 40 per cent; in 1873 (the year that seines became generally used) it was 45 per cent; in 1874 it was 44 per cent; in 1875 it ran down to 25 per cent; in 1876 it was only 14 per cent; in 1877 it was 17 per cent; in 1878 it was 9 per cent; in 1879 it was 6 per cent; in 1880 it was 8 per cent; in 1881 it was 6 per cent; in 1882 it was 15 per cent; in 1883 it was 14 per cent; in 1884 it was 8 per cent; and finally in 1885 it was 7 per cent.

The fish taken in the time included in the bill, both male and female, are poor, unfit for packing, and not very acceptable for the table.

The schools appear on our coast off Cape Hatteras in March, and thence proceed northward, and spawn on the coasts of Massachusetts and Maine. On their first appearance the mackerel fleet meets them, and they are harried and harassed from that time until winter.

Although it is contended by some scientists that all that man can do will have no appreciable effect in depleting the ocean of fish, it is believed by many that the unrelenting pursuit mentioned above has a tendency to deflect them from their course or to prevent many from returning in subsequent years. This latter fact may account for the diminished percentage of No. 1 mackerel.

The whole mackerel fleet is owned in Massachusetts and Maine, consists of nearly 400 sail, employs about 5,000 men, and is now engaged in seining mackerel from March to November. During April and May of 1885 the catch was so great that it glutted the avenues of distribution, and many thousand barrels were thrown away. There is some conflict of testimony as to the amount of this waste, but it was probably between 60,000 and 75,000 barrels.

Your committee have amended the bill to allow fuller latitude to the taking of mackerel by hook and line, and recommend that the amendment be concurred in, and that the bill when so amended do pass.

73.—THE BREEDING HABITS OF THE EEL.

By J. N. SAWYER.

There are, no doubt, many different opinions regarding the breeding habits of the eel. Having lived along the Delaware during the most of my life, and having been engaged in fishing for this slippery customer a great deal, I have made considerable investigations concerning its habits, propagation, &c.

A great many tell me that "they believe the lamper eel to be the mother of all eels, as they find eggs only in them." But this cannot be true, for the different sexes are easily distinguishable in the lamper eel. Their habits are not like those of the common eel. The female nests in shoal water, spawning during the latter part of May; and in June, when we find other eels done spawning, the little ones, two or three inches long, are ascending the river by millions.

I have caught eels in large numbers from early spring until late in the fall, and have always observed two kinds, which I believed to be male and female, thus proving (to *my* mind) the story, "that the female reproduces her species without the aid of the male," to be false. The male eel can be distinguished from the female by his large head on a comparatively small trunk, quite poor, and upon examination internally we can find two longitudinal rows of a bright, glossy appearance, and of a very compact tissue and rounded form. These are the spermatic organs. While in the water he is constantly moving from place to place. What I take to be the female is the one with the smaller head, generally quite fleshy, and, upon examination in the late fall, a whitish substance can be found internally on each side, just in front of the vent, and in which, upon breaking open, can be discovered small eggs, easily seen with the naked eye. I accordingly believe that both the male and the female possess their own natural sexual organs of fecundation and reproduction.

Eels descend the streams in the fall to places where there is deep water, and where mud will serve them as a refuge during the winter. Here I believe they spawn very early in spring, or in late winter, for as early as May large numbers of the little eels can be seen ascending the streams. Some claim "eels all go to salt water to spawn." While some of them do, I do not think they all do, for in the winter of 1836 or 1837 we had what is known as the January flood in the Delaware, and wagon-loads of eels of all sizes were found on low places after the water had subsided. One of my neighbors built a very tight dam, so constructed as not to permit any fish or eels to ascend. By this he overflowed quite a tract of land, and placing some eels in the pond left them to breed. After a period of fifteen or twenty years he placed an eel-weir in the

dam and drew off the water to drain the pond for a meadow, catching barrels of eels of all sizes. These instances cited prove to me that eels do not all return to salt water to spawn, but spawn wherever they find suitable places in ponds or streams.

MILLRIFT, PIKE COUNTY, PA., *August* 23, 1886.

74.—STATISTICS OF THE SEA FISHERIES OF FRANCE FOR THE YEAR 1884.*

[Abstract.]

VESSELS AND MEN.—During the year 1884 there were engaged in the fisheries 23,929 vessels or boats, with a tonnage of 162,467 tons and manned by 87,179 men. To these should be added 346 Italian fishing vessels, manned by 1,098 men, who engaged in fishing on the coasts of the fifth district. In addition to these, 53,713 persons (men, women, and children) engaged in fishing on the shores. These figures, as compared with those of 1883, show an increase of 4,855 men, 1,667 vessels, and 11,142 tons.

The value of the products of the fisheries amounted to 87,961,124 francs [$16,976,496.93],† that is to say, a decrease of 19,265,797 francs [$3,718,298.82] from 1883. The decrease was especially noticed in the cod, herring, and sardine fisheries, and was caused by the course of the sales, which were difficult and not very profitable, owing to the epidemic which visited the south of France in 1884.

The products of the cod fisheries (Newfoundland and Iceland), and of the herring, mackerel, and anchovy fisheries, as well as of all those kinds designated by "other fish," amounted in 1884 to 149,661,099 kilograms [329,942,859 pounds], and in 1883 to 133,131,046 kilograms [293,-500,705 pounds], showing an increase in 1884 of 16,530,053 kilograms [36,442,154 pounds].

There was also an increase in 1884 of 75,844 hectoliters [214,639 bushels] of other shell-fish, 214,344 crustaceans (lobsters, &c.), 256,069 kilograms [564,529 pounds] of shrimps, and 41,116 cubic meters [1,451,-806 cubic feet] of marine fertilizers; while there was a decrease of 736,-556,973 sardines, 38,388,451 oysters, 97,371 hectoliters [275,560 bushels] of mussels, and 643,551 kilograms [1,418,773 pounds] of fish designated "other fish."

COD FISHERIES.—Retarded by the ice, all our vessels had not yet arrived on the fishing grounds by the middle of June. The general mildness of the winter of 1883-'84 caused in the arctic regions an un-

* "*Statistique des pêches maritimes.*" Paris, 1885. Translated from the French by HERMAN JACOBSON.

†Throughout this article reductions have been made according to the following equivalents: 1 franc=19.3 cents; 1 kilogram=2.2046 pounds; 1 hectoliter=2.83 United States bushels; and 1 cubic meter=35.31 cubic feet.

usual breaking up of the ice, the result of which was a very noticeable fall of the temperature on the coasts of Newfoundland. About the middle of September the northeast coast was covered with snow, and Conception Bay, near St. John's, was so blocked up with ice as seriously to interfere with navigation. In the beginning of October there were still icebergs on the Grand Banks. To this circumstance must doubtless be attributed the scarcity of codfish on the coast, while they were found in great abundance on the banks, especially south of Newfoundland. The bank fishers made good hauls, as did also the vessels equipped at St. Pierre. During this year the coast which extends from Cape St. John to White Bay was much more frequented by the cod than the remaining portion of the French shore.

In spite of the increase in the number of vessels, and the large quantity of codfish reported, the Newfoundland fisheries did not yield the desired results. This condition of affairs is due to the circumstance that the prices which the cod fetched in the markets were not very remunerative, both on account of the large quantity of fish and the check which the trade of the Mediterranean ports of France and Spain experienced by reason of the cholera.

We have unfortunately to deplore the loss of two vessels from the port of St. Malo. One (packet No. 2) foundered during the fishing season, and 11 men were lost out of the 20 composing the crew. The other (the Sénorine), fitted out for long voyages, which carried passengers for the St. Pierre and Miquelon fisheries, was a total loss, with the entire crew of 53 men.

THE HERRING FISHERIES.—From the beginning of the fishing season (about June 15) herring appeared in large numbers on the coasts near Lerwick and Aberdeen, but they were of an oily quality. Further on in the season, from August 15 to September 15, the majority of the French fishing vessels were engaged on a stretch of 60 miles, from St. Abb's to Sunderland and on the Dogger Bank, where they found a constantly increasing number of herring of an excellent quality. Finally, during the latter part of October the herring fishers approached Yarmouth, where soon after they closed the fisheries by salting the fish on board. Towards the end of this month the first vessels began the fresh fisheries (catching herring without salting them) in the channel, and continued till some time in January, 1885.

Those vessels which salted the fish on board made on an average about four voyages with full cargoes of fish. But the simultaneous arrivals of a large number of fish crowded the markets with fresh herring, while the stock from the preceding year was far from being exhausted. The result was that the vast majority of the fish did not find any buyers, and had to serve as fertilizers.

THE SARDINE FISHERIES.—During 1884 sardines appeared on the coasts at long intervals, and then only for a short time. Those fisher-

men who principally engage in these fisheries, and particularly those who had special vessels constructed for this purpose, felt the failure of these fisheries very keenly. Moreover, the high price of bait tended to swallow up the small profits which were realized. In some parts of the country some of the fishermen abandoned these fisheries in order to devote themselves to catching those kinds designated by "other fish," and given below under the heading "Fisheries for fresh fish."

In spite of the fact that sardines were scarce the prices did not rise much. Several establishments for canning sardines did no work at all. The consequence was that the families of the fishermen, who compose almost exclusively the population of some of our coast villages, were, during the winter, reduced to abject want.

FISHERIES FOR FRESH FISH.—These fisheries (comprising turbot, halibut, sole, flounder, ray, gurnet, mullet, eel, salmon, lamprey, sturgeon, tunny, &c.), which at the beginning of the season were not very productive, owing to long-continued calm during the summer, gave better results during the winter. The products of these fisheries were somewhat less than during the preceding season, but found a ready and profitable sale. The increase in the prices was caused in part by the large number of tunnies caught by the fishing vessels, and delivered to the factories at higher prices than those which could be obtained in 1883. The fisheries carried on by vessels with seines also contributed their share towards this increase.

OYSTER FISHERIES.—In 1883 there were sold 157,666,246 oysters (French and Portuguese), the yield of the coast and boat fisheries, which realized 2,266,578 francs [$437,449.55], while in 1884 there were sold 119,277,795 oysters for 1,744,935 francs [$336,772.45]; consequently there was a decrease from last year of 38,388,451 oysters and 521,643 francs [$100,677.10]. During 1884 the total number of oysters (French and Portuguese) from parcs, tanks, and ponds, as well as from the coast and boat fisheries, sold during the season amounted to 529,768,767, yielding a sum of 13,577,926 francs [$2,620,539.72].

The season of 1884 commenced under favorable auspices; but the epidemic which visited Southern France and Spain caused a very noticeable decrease in most kinds of business. The sale of oysters was consequently not so active as during the preceding years, and the prices of course fell very considerably. In spite of these drawbacks oyster culture continued to make progress. The harvest of oyster spawn was unusually rich in the River Auray, whose beds always contain an abundance of oysters. The same was the case at La Teste, Cancale, the Island of Oléron, at Marennes, and in the principal centers of oyster production, where the raising of oysters is carried on at a constantly increasing rate.

PARIS, FRANCE, *November* 4, 1885.

75.—OBSERVATIONS ON MALE EELS.*

By Prof. P. PAVESI.

It would be useless to repeat the history of the investigations relative to the reproduction of the eel, because it is well known,† and because Dr. Jacoby, in his work "*Der Fischfang in der Lagune von Comacchio, &c.* (The Fisheries in the Lagoon of Comacchio, &c.), has treated the subject in such an exhaustive manner. But I will state that on December 28, 1871, Professor Ercolani, before the Academy of Bologne, and on January 11, 1872, Professors Balsamo and Maggi, before the same Academy, declared that the eel was a perfect specimen of a hermaphrodite, there having been found in one and the same eel organs which certainly were male, together with ovaries. The question, therefore, seemed completely solved, and Professor Cornalia expressed his delight "that the mystery which enveloped the question of its reproduction had been solved, and that these fish could really be termed hermaphrodites," and added that he was "very glad this result had been obtained by Italians, while none of the illustrious foreigners who had been sent to Italy on special missions to study the fish-cultural establishments on the coasts of Italy had been able to make the discovery." A number of professors at various Italian universities published articles and pamphlets on this achievement, some of which were translated into French and German. The only person who declared these statements premature, and opposed the views of Balsamo and Maggi, was Professor Canestrini. The matter now rested for a while, till 1874, when Professor Syrski, of the Austrian university at Lemberg, published a treatise in the reports of the Vienna Academy of Sciences, on studies made by him at Trieste. He selected for his observations small eels, about 40^{cm} [15¾ inches] in length, having regard to the general fact mentioned by Günther and Darwin, that probably there is no kind of fish in which the males are not smaller than the females.‡ In some of these eels he found a small organ which he called the "lappenorgan" (the rag-organ), which, although there were no certain indications of the presence of spermatozoa, he did not hesitate to consider as a male organ. Claus, Siebold, and Virchow now began to occupy themselves with this question; and Freud declared that this organ showed great similarity to the histological structure of the testicles; while Jacoby wrote: "The supposed testicles of the eel, described by Ercolani, Crivelli, and Maggi, show, as is proved by a most careful investigation, not the slightest trace of a testicle-like

* Extract from a paper read before the Royal Institute of Lombardy, July 1, 1880. Translated from the Italian by HERMAN JACOBSON.

† For a very full article on this and connected subjects, see F. C. Bulletin, Vol. I, 1881, p. 71.

‡ See F. C. Bulletin for 1881, p. 85.

structure." The controversy began to grow hot. Siebold did not rest until in 1875 he found many male eels in the Baltic near Wismar. Late in the autumn of 1877 Professor Jacoby came to Comacchio to resume his researches. The German Fishery Association stirred up all the fishermen and fish-culturists of Germany, by promising a reward to any one who would send male eels to Professor Virchow at Berlin. Dr. Pauly, of Monaco, with the assistance of Mr. Keiffer, anatomized some eels, and sent one to Professor Benecke of the University of Königsberg, who entirely confirmed the result of Dr. Pauly's patient researches; as also did Dr. Hermes. Meanwhile there came from America the announcement through Prof. A. S. Packard, of Brown University, in the first number of the Zoologischer Anzeiger for 1879, that Mr. Edwards, of Boston, Mass., had, in December, 1875, found males of the *Anguilla bostoniensis*. It is true that soon after Professor Packard corrected his own statement, in an article inserted in the American Naturalist, to the effect that the supposed spermatozoa were cells with a molecular movement; while Jacoby wrote: "The alleged spermatozoa described in the work of Maggi and Crivelli, are nothing but microscopic fatty particles, or small crystalline bodies, such as are frequently found in fat cells." It could not be supposed, however, that the organs considered as testicles by Balsamo [Crivelli] and Maggi, were a fatty degeneration of the Syrskian organ, both on account of their structure and their different location.

From the preparations and diagrams which I saw at the Berlin Exposition in 1880, it appears that the testicles are stretched along the body cavity in the shape of two lobular bands. They are covered by a large number of fatty cells. They commence at the liver and pass the anal aperture, the left one a little further than the right, and finally end in a point. When fresh they are said to be clear and transparent, but in alcohol they become opaque. Under the rectum, and over the urinary bladder there is a seminal bag, which terminates in a small tube at the anal aperture. The two live eels which were exhibited in the Berlin aquarium came from Dr. Hermes, in Trieste, and were, after a careful external examination by Dr. Jacoby and Dr. Græffe, determined as male eels. When one of them died, Dr. Hermes very kindly presented the organs referred to to the Berlin aquarium. On examination it was found that these fish were thirty to forty centimeters [12 to 16 inches] long, of an olive-green color on the upper, and a silverish-white color on the lower part. These two colors were very distinct; and there was a blackish spot of an oblong shape in the opercular region. They generally preferred to hide at the bottom of the aquarium among the aquatic plants, but occasionally swam about in the open water.

The above-mentioned characteristics are only individual, although they formed the distinguishing marks of those which possessed the

Syrskian organs. Syrski states that their greatest length is 430 millimeters [17 inches]. The eight specimens measured by Jacoby varied in length from 319 to 480 [12½ to 19 inches], and those measured by Cattie from 270 to 380 millimeters [10½ to 15 inches]. In the males, moreover, the distance between the nasal tubes is greater; the dorsal fin is higher and broader; the diameter of the eyes is noticeably larger, comparing individuals of medium size. But these characteristics, in my opinion, make it doubtful whether these fish were young specimens, because in other fish the young may be recognized by the great development of the fins and the comparative great size of the eyes. Jacoby maintains that another sexual difference consists in the color, while Cattie denies this and maintains, on the other hand, that the difference in the shape of the head is of greater importance—the female is said to have a pointed and the male a round head. The males are said to form about 20 per cent of all the eels.

Not less important are the results of Jacoby's observations regarding the migration and the spawning season. The fact of the ascent of the eels, called at Comacchio "*capillari*" (hair-like), and at the mouth of the Arno "*cicche*" (blind eels), has long been known in Italy, and on it is based one of our principal fishing industries. Thus from time immemorial the descent of the adult eels towards the sea has been explained as being caused by their desire to spawn. There is no longer any doubt that Jacoby found them on the coasts of the Adriatic by thousands; but he also found that these eels migrate in autumn when their stomachs and intestines are entirely empty, and that those which remain are nothing but barren females. Probably all the eels of our rivers, ponds, and lakes are females, because the males stay in the sea near the mouths of rivers, where they wait for the females to come to them.

The perfect development and the functions of the sexual organs seem to be of very short duration; in fact, the descent of the eels takes place from the beginning of October till the end of December; and already in January, February, and March, as Mr. Richardi, of Pisa, informs me, the so-called "blind eels" ascend. It is possible, also, as Jacoby thinks, that the reproducing individuals die after the act of generation, just as Panizza always found the dead lampreys (*Petromyzon marinus*) void of eggs and milt.

There is lacking all decisive proof of the presence of spermatozoa in the Syrskian organs; they cannot, therefore, with absolute certainty be considered as testicles;* and the depth of the sea hides from our eyes the method of fecundation and the first development; but the truth is nevertheless plain, and the idea of the hermaphrodism of the eel may be considered as entirely exploded.

PAVIA, ITALY, *July* 1, 1880.

* See article by J. A. Ryder in F. C. Bulletin for 1885, p. 1.

Vol. VI, No. 15. Washington, D. C. Oct. 27, 1886.

76.—REPORT ON THE ARTIFICIAL FECUNDATION AND GENERATION OF OYSTERS.*

By G. BOUCHON-BRANDELY,
Secretary of the College of France.

Our experiments in the artificial fecundation of Portuguese oysters were made during the course of 1883 at different points on the coast. Before giving an account of the results obtained, and of some new observations which we were fortunate enough to make during the year, it is necessary to point out a fact which, in our opinion, is of the greatest importance as regards the subject in question, and which shows that we were right in stating in our last year's report to the minister of marine that the artificial fecundation of oysters opened out new prospects to the industry of oyster culture.

The following is the fact referred to, which was first reported by an English journal. In the beginning of September, 1883, the Pall Mall Gazette contained the following:

"Mr. J. A. Ryder, professor of embryology, attached to the U. S. Fish Commission, is said to have solved at last the problem of the reproduction of oysters from artificially fecundated eggs. The correspondent of the Pall Mall Gazette reports that on September 4 he saw, at the Government fish-cultural station, at Stockton, Md., several thousands of young oysters, a quarter of an inch in diameter, which had been produced from artificially fecundated eggs, and had been hatched at the station forty-six days previous."

To the honor of the administration of marine, under whose auspices we have made these experiments, let it be stated that the first application of the methods of artificial fecundation was made in France, and through our efforts, as appears from a notice presented by us last year to the Academy of Sciences, which was entered in the acts of the Academy under date of July 31, and from a report on our operations to the minister of marine published in the *Journal Officiel* and in the *Revue Maritime.*

After having made this statement we are happy to acknowledge the success of the Americans. Their success is full of encouragement, from which we hope our French oyster cultivators will profit. We also learn therefrom that, thanks to the new methods, it is possible to acclimatize in France some of the fine varieties of oysters found on the coasts of

* "*Rapport sur la fécondation artificielle et la génération des huîtres,*" Paris, 1884. Translated from the French by HERMAN JACOBSON.

the New World, which, owing to their sexuality, are, like the Portuguese oyster, suitable for artificial reproduction, and are in many respects. especially as regards their flavor and size, superior to the Portuguese oyster.

The following has been the endeavor of our researches during this year:

1. To find out whether artificial fecundation could yield practical results in entirely closed waters; and

2. To ascertain whether the raising of the Portuguese oyster is possible and profitable in the ponds on the Mediterranean.

To begin with, it should be stated that it appears from observations made both on the coasts of the Mediterranean and of the Atlantic Ocean that aeration, a constant renewal of the water, and also its agitation, are necessary for succeeding in certain cases, especially when the temperature is high. Up to a certain point, heat favors the hatching of the eggs and the development of the embryos produced from them; but if it passes this point, it causes the rapid decomposition of the generative elements and the death of the young embryos. To operate under such a condition will almost certainly result in failure.

The majority of the experiments made during the last season have proved this beyond dispute. At Verdon these experiments were made in the salt marshes where we had previously been stationed. We had purposely isolated one of the experimenting reservoirs, so that the fresh water of the tide could not get into it. In this closed reservoir, there were placed, at different intervals, the fecundated products of at least a hundred male and female oysters; while in a larger reservoir, which received fresh water at every tide, there was placed the fry of only a dozen breeders. The result was that the collectors placed in the closed marsh remained free from spat, while each of the tiles placed in the reservoir, where the water entered and flowed off freely, contained from thirty to forty young oysters. This may to some extent be explained by the want of aeration and agitation, but it must be attributed principally to the high temperature of the water. In fact, when the embryos were placed in the reservoir, which was at the time when the most intense heat of summer sets in, it was found that there was a considerable difference between the temperature of the water in the open reservoir and that of the closed one. Similar observations were made at Cette and at Berre, in the reservoirs which the Southern Salt-Works Company had kindly placed at our disposal.

We must here give an important observation, made on the shores of the Mediterranean, relative to the forwardness of the oysters raised in the waters of the south as regards reproduction. We found that the oysters transferred last year from Verdon to the pond of Thau and the pond of Lattes were capable of propagating at the end of May. Artificial fecundation attempted at this period produced ninety lively em-

bryos from about one hundred eggs treated. Less than a month later all these oysters had spawned.

Another observation was made at Toulon. It was our good fortune to have as our co-worker M. Sénès, the principal administrative agent of marine, whose ability in matters relating to oyster culture is universally acknowledged. In the course of the month of July, when the scorching heat on the shores of the Mediterranean was most intense, M. Sénès received from Verdon breeders which, when shipped, were ascertained to be fully capable of exercising the generative functions, and which, immediately upon their arrival, were placed at the most favorable points in the roadstead of Toulon. All the efforts made by M. Sénès and myself to have the eggs hatched were in vain. Fission set in, and the eggs reached an advanced stage of development, but the process was not completed. This state of infecundity lasted during the months of July and August, and in some cases continued till the middle of September, and in a few even till the beginning of October. Not till then did M. Sénès obtain lively embryos.

Other oysters which had for some time been accustomed to the waters of the roadstead exhibited nearly the same phenomena. Although we ascertained as early as July that the generative elements were on the point of arriving at maturity, the tendency toward reproduction did not manifest itself in these specimens in a manner which promised results till the month of October, that is to say, almost three months later.*

We should add that most of the time fecundation did not succeed as well at Cette as at Verdon during the hot season, because in the latter place the precaution was taken to use only cooler water, and because the elements were brought together in receivers large enough to prevent the effect of the surrounding atmosphere from being felt too quickly. It was also necessary to change the water several times during the course of incubation. Subsequent researches have shown that the incubation of the eggs and the development of the embryos in water whose temperature exceeds 32° C. [89.6° Fahr.] can hardly be accomplished. Is this also the case with the American oysters and the unisexual oysters of the Indian Ocean? We hope soon to hear this question answered.

After stating that the experiments made at the island of Aix, in the moats of the fortifications, whose water is not sufficiently renewed and not at all aerated, were seriously interfered with by the stormy weather and the excessive heat, and yielded fewer results than we had anticipated, considering the successful manner in which fecundation had been accomplished, we give below a brief report on experiments made at the mouth of the Loire, at Pouliguen, in the oyster-cultural establishments

* We must here state that the opinion expressed in our last year's report as regards the infecundity of Portuguese oysters penned in Mediterranean waters is contradicted by this observation.

of M. Laurent, director of the Transatlantic Company. These researches were made under the direction of Pierre Laurent, the son of the learned director, a summary account of whose labors is here given.

REPORT OF PIERRE LAURENT.—Our parks at Pouliguen are located in the old abandoned salt marshes which have been appropriated for the cultivation of oysters and fish. The water is brought into them by a canal 500 meters [1,640 feet] long, which opens in the harbor of Pouliguen. There are gates which allow the different reservoirs to be emptied and filled.

The experiments were made in two separate basins, whose supply of water is kept absolutely separate, and whose levels differ 1 meter [3¼ feet]. The first is a *claire* having an area of 50 square meters [about 538 square feet] and a depth of 90 centimeters [about 3 feet]. The second is an old salt-pit, having an area of 11,000 square meters [nearly 2¾ acres]. The water of the *claire* was partially renewed at every tide; while the water of the salt-pit was renewed only by strong tides, and on account of its large surface was continually agitated by a strong splashing. The same kinds of collectors were placed in these basins. They consisted of the shells of mussels and oysters, pieces of calcareous stones, and potsherds.

While these experiments were going on the saltness of the water varied between 2.5° and 3.2°; it being naturally greater in the salt-pit, where the water was rarely renewed, than in the *claire* where it was renewed nearly every day.

Under conditions differing so much, both as regards the saltness of the water and its renewal and agitation, the results obtained were identical. The spat attached itself in great quantities to the collectors, especially to those which presented a rough surface, such as the oyster-shells, calcareous stones, and potsherds. Some fagots used as collectors remained bare, which may perhaps be ascribed to the slow decomposition of the wood in the closed water. Nevertheless the results were on the whole very remarkable. On certain shells as many as 300 young oysters could be counted; and if we take an average of 60 to 80 per shell, we are certainly below the actual facts.

The following was the method pursued for obtaining embryos: We took simultaneously or successively as reproducers: (1) Oysters from the Government bed at Verdon, which the commissioner of marine at Pauillac had sent us; (2) oysters originating at Arcachon, which had been penned in our establishments for a year, and which never before had shown any trace of reproduction. (These oysters are in a basin entirely separated from the former.) The experiments succeeded equally well in both cases, and the results were essentially the same, only the Verdon oysters appeared, as regards the maturity of their seminal liquids, to be eight or ten days ahead of those from Arcachon.

We threw the eggs and spermatozoa detatched from the seminal glands into a large glass vessel containing 30 liters [about 8 gallons] of

water; we put in the liquid at intervals of from five to ten minutes. During that time the eggs reached the bottom of the vessel, carrying with them the spermatozoa which surrounded them. There remained floating only infecund eggs, the overplus of spermatozoa, and organic matter. Then, by means of a siphon and another reservoir we caused a current of water to pass into the glass vessel, regulating the flow in such a manner as to let in during one hour a quantity of water almost equal to that contained in it. To prevent the current from raising the eggs from the bottom of the vessel, the longer branch of the siphon opened out into a little glass saucer floating in the water. In this way the water was continually kept pure by the current during the entire process of incubation. Useless organic matter, which rapidly decomposes in the water, was thus carried off, and the aeration of the water was constant and perfect. (See Plate II.)

Several comparative experiments have demonstrated the superiority of this system. I think that the eggs should not be deposited on the bottom in too thick layers, and that a depth of water of 15 to 20 centimeters [6 to 8 inches] is sufficient.

We made twelve such experiments from July 19 to August 27. The proportion of embryos obtained to the number of eggs used increased from 5 or 6 per cent to 80 or 90 per cent. These latter results, however, were not obtained till August.

The duration of the incubation was from five to twelve hours, according to the temperature. A thermometer plunged into the water showed a variation of 12° to 29°. It was noticed that the higher the temperature the more rapid was the incubation and the greater the result. I think it is preferable, however, that the temperature in the vessel should not greatly exceed that of the water in which the embryos are to be planted, so as not to expose them to too great and sudden a change. As soon as there were enough lively embryos in the glass vessel they were poured on the collectors as uniformly as possible.

Only the fecundations which took place in August produced spat; and they were also the only ones which yielded any considerable result. Ten to fifteen days after the last sexual liquid had been poured into the glass vessel perfectly formed little oysters could be distinguished on the collectors with the naked eye. For some days a decided growth was observed in them. Unfortunately the precautions taken against an accumulation of mud were not sufficient, and gradually the mud began to cover the collectors and caused the spat to disappear.

To sum up: The experiments at fecundation made at Pouliguen were perfectly successful, in that (1) we obtained embryos which became fixed to collectors, and began to develop on them; and (2) we have shown the possibility of using as reproducers oysters raised in our country. These experiments will again be taken up next year, and promise a still more complete success, that is to say, the entire development of the young oysters.

This question is of the greatest importance to oyster cultivators. Besides showing the possibility of producing oysters by a truly practical and industrial process, artificial fecundation, according to the method of Bouchon-Brandely, makes it possible to improve the breeds by selection and crossing. It will perhaps also make it possible to acclimatize in France foreign unisexual oysters, such as the American oyster and the pearl oyster.

It will, moreover, furnish the means to devote to a remunerative industry immense tracts of land on the shores of the ocean which were formerly devoted to the production of salt, an industry which, at present, is on the decline. In the salt region of Croisic alone there are 2,700 hectares [nearly 7,000 acres], a great portion of which is at present not under cultivation, while the rest is almost barren. A larger and richer center of oyster culture than that of La Tremblade might here be established.

Although recognizing the validity of the reason given by Mr. Laurent for the mortality of the young spawn, we think that there are still other reasons why the experiments made this year were not altogether successful, at least not so successful as the fine results obtained last year at Verdon led us to expect.

Not only was the weather very disagreeable during the entire spawning season, but the winter which preceded it was one of the most severe known in many years. The losses experienced by the oyster cultivators of Marennes, La Tremblade, Arcachon, &c., were very considerable. There was incessant rain for several months, and the oysters became very soft; and although the Portuguese oyster, which seems to have greater vitality, was not specially affected by the brackish water, its fecundity seems nevertheless to have considerably decreased from this cause. We observed that the oysters from the Gironde, when the spawn was emitted, were much smaller than those of last year, whose shells were filled to repletion on account of the sexual gland being so full.

The late season when the eggs were laid also indicates some trouble in the generative evolution. Last year, at Verdon, there were successful fecundations from the last half of June; this year there were none till the end of August.

We have to give a brief account of our attempts to raise Portuguese oysters in the waters of the Mediterranean, especially in the ponds of Languedoc and Roussillon. It is well known that for some years Mr. Malespine has obtained good results in this respect in the waters of the roadstead of Toulon. The experiments which we made in the ponds of Thau, Mauguio, and others were just as satisfactory. Oysters which had come from Verdon in spring, and were placed in the pond of Lattes grew 4 centimeters [about 1½ inches] in two and a half months. The growth was particularly noticeable during the months of April, May,

and June. These oysters, inclosed in wooden boxes, the upper and lower portion of which was composed of laths about a centimeter apart, were placed in the deepest parts of the lagoon, on bottoms almost $1\frac{1}{2}$ meters [5 feet] deep.

It should be stated that there was considerable mortality among the oysters, but as we ascertained later this was caused by a little fish very common in the lagoons of the south, of a harmless appearance, but exceedingly voracious, called the goby. Wherever there was any considerable loss, both in the oyster-boxes and in the fish-pots, we noticed these little fish. What was particularly surprising was to see by the side of oysters whose death might be attributed to different causes others which were in good condition and evidently developing in a healthy manner. A sick oyster which will finally succumb does not grow. One day, when raising one of the boxes deposited in the pond of Lattes, we found in it such fine, fat, and large gobies that they could no longer escape from the box, owing to their size. Having evidently found in this box something that was very much to their taste, they had established themselves in it. But they had reached their fine condition at the expense of our oysters, most of which were dead and half of them had been devoured. Further observations have shown that the goby is really a dangerous enemy to the oyster. The oysters may be protected against them by having the boxes covered with a close net-work of metal.

We were fortunate enough to have another proof during last season of the remarkable vitality of the Portuguese oyster. In the pond of La Nouvelle oysters of this variety lived several months in water containing so little salt that the densimeter scarcely indicated the presence of salt at all.

In short, large portions of the ponds of Berre, Mauguio, Thau, La Nouvelle, and Leucate appear perfectly adapted to the cultivation of the Portuguese oyster.

EXPERIMENTS WITH COMMON OYSTERS.

At the same time when we commenced our experiments with the artificial fecundation of Portuguese oysters we undertook a series of experiments relative to the incubation, hatching of the eggs, development, and fixation of the embryos of the common oyster.

We shall pass as rapidly as possible the mere technical parts of certain questions; but to make this report clear it is necessary to give a succinct account, from an embryological point of view, of the natural history of the mollusk in question.

The ordinary oyster, known as the *Ostrea edulis*, is a hermaphrodite. Among Frenchmen, Quatrefages, Lacaze-Duthiers, Milne-Edwards, Coste, Gerbe, Davaine, and others; and among foreigners, Eyton, Mö-

bius, Hart, and others have written excellent works on the oyster, and all of them reach the same conclusion.*

We have already stated in a former report that there was a time when this question of the hermaphrodism of the oyster possessed some real interest; the time when public opinion went into ecstasies over the discovery of the artificial fecundation of fish eggs by Messrs. Géhin and Remy, two fishermen of the Vosges Mountains. People lived in hopes that the method of artificial fecundation which succeeded so well with salmonoids might also be applied to mollusks. One began to look even further—as we see from various communications made to the Academy of Sciences—and hoped that our race of oysters might be improved by cross-breeding. It was, therefore, important to know whether the sexes of this mollusk were separate. It was found that hermaphrodism was the rule with the *Ostrea edulis*, consequently the projected plan of operation became impossible.

Hermaphrodism is not the only cause which prevents the success of artificial fecundation as regards the common oyster. Would it be possible to practice this method with hope of success without being previously assured that the eggs are mature? and how can this be ascertained, and how can the eggs be brought into direct contact with the fecundating element, considering the fact that impregnation takes place inside the shells, and probably in the oviducts? And even supposing that the eggs and the fecundating element could be brought together, artificial fecundation would not yet yield any practical result, in view of the fact that the eggs and the embryos of the *Ostrea edulis*, which should necessarily be treated separately, cannot develop or even live outside of the liquid secreted by the mother oyster and contained in the incubatory cavity of its shell.

The inquiry whether the oyster is a complete hermaphrodite, that is to say, whether it is capable of generating without the aid of another oyster, has given rise to very interesting researches; but as this special question of embryology can hardly be of interest in this report, we shall confine ourselves to giving a brief recapitulation of the different opinions

* By the generic term *Ostrea edulis* we understand most of the varieties of oysters caught on the coast of Europe, namely, the violet-colored oyster with white stripes, called the bi-colored oyster of Brittany; the oyster with violet streaks from the basin of Arcachon; the reddish oyster from the river Quimper; the oyster with mother-of-pearl shell from the bank of Dives; the wandering oyster from the island of Ré; the cinnamon-colored oyster from the river Bélon and the Arcachon basin; the green oyster of Marennes and La Tremblade; the brown oyster from the roadstead of Toulon; the oyster with a thick white shell which was formerly caught near Cette, Port-de-Bone, and other places on the Mediterranean; the rough-shell oyster of Corsica; the Isle of Wight oyster; the small English oyster, and two varieties, the *Ostrea tincta*, and the *Ostrea deformis;* the rose-colored oyster from the cold waters of Norway; the large Baltic oyster; the thick-shell oyster from the Ionian Sea; the Adriatic oyster; the Balearic oyster; the Santander oyster; the horse-foot oyster; the small Toulon oyster, which is also found in the Bay of Genoa and in the Bay of Naples, and whose scientific name is *Ostrea plicatula* or *Ostrea stentina*.

which have been advanced. Some authors have asserted that fecundation takes place in the ovary by a contact effected between the two generating elements, when these elements, which are formed in one and the same gland, both arrive at the condition of maturity, so that all the eggs would be fecundated when they pass into the oviducts. It has also been stated that the embryo is completely formed (that is, provided with shells) when it passes from the ovary into the mantle of the mother oyster. This latter opinion is entirely erroneous, for by examining the white spawn of oysters it will be seen that the eggs which compose it are mostly in the very first stage of their development.

One of our most distinguished naturalists, Lacaze-Duthiers, has found the truth by showing that the oyster is a hermaphrodite, performing by turns, but never simultaneously, the functions of each sex; and that the fecundation of the eggs which probably takes place in the generative orifices, is accomplished by the participation of another oyster. The observations which we made in the laboratory of M. Balbiani, at the College of France, corroborate this opinion of the great French zoologist, which is also shared by Möbius. We have never yet found, in one and the same gland, eggs and spermatozoa, the two generative elements, in the same stage of development; and we have never seen these two elements reach maturity at the same time. From this we have drawn the logical conclusion that they do not come in contact with each other.*

The spawning season of the *Ostrea edulis* occurs at different periods and varies very much in length. Sometimes it commences in April and does not end till some time in September. Even in December oysters containing embryos have been found. Sometimes the spawning season does not begin till May or June and ends in August. It is regulated by the temperature of the season and by the mildness or severity of the preceding winter. In June and July, however, the emission of spawn is generally most abundant.

The activity of the reproductive organ is, so to speak, constant. After the embryos have been emitted the oyster, which has become very lean, begins to pick up again, and soon arrives at a state of repletion similar to that which it possessed before spawning, but which is due to the presence of fat around the gland. This is the time when it is most sought after for the market. But while the accumulation of fat is going on epithelial cells develop, which later are transformed and bring forth the generative elements. When the weather is mild, even in winter, the transformation takes place very rapidly. We have fre-

* It will be seen further on that the eggs of the *Ostrea edulis* perish in pure sea-water. This is not the case with zoosperms. These, while they are inside the gland, are not vigorous, no matter what stage of development they have reached. But as soon as they are brought in contact with sea-water they become animated and begin to vibrate. It would seem that they do not acquire their fecundating quality until they have been in the water for a while. This would be another argument against autofecundation.

quently in January found in the glands producing eggs and sperm small but well-formed eggs and spermatic animalcula, which had only to be brought in contact with the sea-water to produce animation and vibration.

From April and May the first milky oysters are found. The term "milky" is employed because the spawning products, when emitted, present the appearance of thick milk. But when this so-called "milk" is examined under the microscope it will be found to consist partly of freshly fecundated eggs, partly of eggs which have already split, and of embryos recently hatched. As these develop, the whitish color of the spawn changes and it turns gray; and when they approach their complete transformation and full maturity, their color gradually turns from a dark gray to black.

The number of embryos produced by a single oyster during the year is estimated at from 1,200,000 to 1,500,000.* The embryos are sheltered in the folds of the mantle of the mother oyster for a period whose length has not yet been ascertained, and find in the mucilaginous liquid in which they live the nutritive elements which they need in order to reach the period when their roving or pelagic life commences.

Some naturalists have asserted that the oyster can spawn twice in one year. What has given rise to this supposition is the circumstance that frequently during the spawning season there are two well-defined emissions, the first about the beginning of June, the second towards the end of August.

The following experiment shows that there is no good reason for this opinion, and that it is not founded on facts. Proposing to follow up the incubation of the eggs and the transformation of the embryos in the interior of the shell, we perforated the upper valve of several mother oysters. This opening, which was made directly opposite the incubatory cavity, was corked up, so that no water could enter the oyster, and we could at any time take the observations which the experiment required. As regards the principal object of the inquiry, the data gathered by us were not very precise, as most of the oysters which had been perforated had emitted their spawn, either at the time when the operation of perforating the shell took place, or one, two, or four days afterwards; but as regards the final development of the genital gland, we could see this gland re-form, grow, and become covered with fat; and although the specimens examined by us had produced embryos from the beginning of the spawning season, we never noticed that they were in condition to emit others at the end of the season.

* M. Gerbe, the distinguished co-worker of M. Coste, who has taken so large and active a share in the work of the last-named naturalist, has found that oysters may be considered adult when they have reached the age of one year. Oysters of this age, by reason of their size, are not as fecund as those of which we are about to speak. These measure 8 to 10 centimeters [about 3½ inches], a size which is usually not reached until they are three to four years old.

Fearing that the trepanning operation might have disturbed the generative functions of the oysters we made another experiment which entirely confirmed the former. In the very beginning of the season, towards the end of April, we selected some oysters in which we had observed spawn, and placed them separately in a very fine bed where they would find all the conditions for reproduction in the greatest perfection. When opened in September, at the time when the last breeders emitted their embryos, cuts made in their full glands proved conclusively that they could not have spawned again before the following spring.

There remains the supposition that there is an annual spawning season in several successive emissions. It is possible and probable that ovulation is not accomplished at one time and in a single day, but it cannot be supposed that there is an interval of several months between the emissions, like that between the period of June and the period of September. We have, moreover, noticed that when, in an oyster engaged in the process of gestation, the eggs remained in the oviducts they were invariably damaged or sickly. It appears to us, therefore, that one spawning per season is the rule in the common oyster, as well as in the Portuguese oyster, and that any variations from this rule are anomalies, like oysters spawning in December or January.*

The idea of keeping and raising in close waters the embryos of the oyster, and to find them later on the collectors, has tempted many per-

*As we deemed the trepanning process referred to above eminently suitable for facilitating the study of certain questions of natural history, some of which concern directly the science and industry of oyster culture, we consider it proper to add some details to the information already furnished.

The fact of making an opening, even comparatively large—the trepan which we used measured not less than 1½ centimeters [over one-half inch] in diameter—in the valves of an oyster does in no wise endanger its life. It is advisable, however, to work the trepan with caution when the perforating process approaches its end, so as not to injure the animal. A slight wound, however, will heal very quickly. After the hole has been made, and the little pieces of shell which have fallen into it have been removed, it becomes necessary to stop up the opening as firmly as possible, either with a piece of cork, wax, or some other substance.

The closing up of the hole is to prevent lice, small crustaceans, &c., from penetrating into the shell, or attacking the animal at a defenseless point, and also to prevent the water from entering the shell. If the oyster which has been thus operated upon is placed in a good park, and if it is in a period of vigorous growth, the cicatrization, or the restoration of the shell, is accomplished within a week. It is not absolutely complete, but the animal has covered the cork with a thin shell of mother-of-pearl, which protects it against outside enemies. In some oysters which we observed we could only counteract the too rapid formation of this mother-of-pearl by turning the cork several times every two or three days.

In this manner we have made as many as five holes in the shells of French and Portuguese oysters, and they had been so little hurt by the operation that they were exhibited last year at the Bordeaux Exposition, and still bore on their shells the marks caused by our experiments.

sons, and we must confess that we have not escaped the seductions of this idea.*

In June, 1880, we arranged in the laboratory of M. Balbiani, at the College of France, a contrivance destined for the artificial incubation of oyster eggs and the fixation of embryos, composed of a series of tubs through which a constant current of filtered and aerated sea-water circulated. (See Plates III and IV.) Eggs in every stage of development and embryos of every age were placed, each separately, in the different apparatuses. A layer of fine sand, placed towards the outflow of each tub, permitted the water to flow out easily, while the young oysters and eggs remained safely inside, it being impossible for them to escape.

The oysters from which the subjects for our experiments had been drawn came partly from Arcachon and partly from Brittany, and arrived in a perfect state of preservation and freshness. The following took place: Some hours after they had been extracted from the mantle of the mother oyster, and had been placed in one of the incubating boxes, the eggs which were at the point of splitting ceased to develop and commenced to decay. Embryos in the condition of white spawn, although very lively when placed in the water, became motionless, and died after three or four days, according to their degree of development; while

*As regards collectors, we have heard a man who is exceedingly competent and thoroughly conversant with all matters pertaining to oyster culture advance a theory, which we deem proper to report without, however, passing any opinion as to its value: Is it indispensable for the young oyster to attach itself to some object in order to live and grow? When it is in its natural state there is not the slightest doubt in this respect. The currents to which the embryo is exposed compel it to attach itself to some object, if it is not to be buried in the mud or tossed about, injured, or suffocated by the waves. But under certain conditions, on a suitable bottom, on sand free from sediment, where very pure water circulates slowly, would it not be possible for the young oyster to develop without an object to which it is fixed, which object under all circumstances is only of temporary use, because it may, with impunity, be removed from it a few days after it has become fixed? At the time when the spawn is black the embryo is nearly perfect. Some may be seen whose ciliary apparatus is so much reduced that they can hardly move. Their two valves, however, work well; in short, they differ from an adult oyster only by their small size and the convexity of their shells.

At the agricultural exposition of Edinburgh an oyster cultivator exhibited small oysters which appeared independent; but he did not tell how he obtained them, nor could he prove that they would be able to raise themselves. Possibly they were only embryos in an advanced stage of development.

In this connection we will relate a circumstance which occurred at a reservoir of M. Léon Lesca, counselor-general of the Gironde, and owner of fish ponds on the banks of the Arcachon basin. Four years ago Mr. Lesca observed in one of his reservoirs small oysters which appeared to have been deposited on, rather than attached to, the gravel and broken pieces of algæ at the bottom of the pond. This discovery was not without interest, as spawn of oysters had never been seen in that pond. The oysters were allowed to grow freely, without giving them the least care, in order to see what would become of them. Mr. Lesca has recently sent us some specimens of these oysters, which had reached an average size of 9 to 12 centimeters [about 4 inches], and in several of them we noticed that there was no place for attachment; or, at any rate, it was not visible.

embryos in the condition of black spawn held out eight or ten days. But as they approached that time they could be seen to grow more feeble every day, and finally to succumb, none of them having become fixed to the collectors placed in the boxes.

Thinking that the location (light and air being lacking) was not favorable for such delicate experiments, we went to Arcachon to repeat them there. Messrs. de Montaugé extended to us the hospitality of their establishment of St. Joseph; they placed at our disposal the laboratory which they had organized, and the reservoirs surrounding this laboratory, reservoirs in which the water could be renewed at every tide.

An apparatus on the same model as that which we had used at the College of France was constructed, and eggs and embryos were placed in it as at the first experiment. The result did not answer our expectations any better, and it became necessary to change our method of experimenting. We now determined to establish ourselves at the large reservoirs referred to. The difficulty was to keep the spawn in compartments spacious enough to make them feel just as much at their ease as in open water and at the same time to have a constant renewal of water in all the compartments. Two board frames, perforated, the one measuring $3\frac{1}{2}$ meters long and broad by 70 centimeters high [$11\frac{1}{2} \times 11\frac{1}{2} \times 2\frac{1}{3}$ feet, about], the other measuring $2\frac{1}{2}$ meters long and broad and 70 centimeters high [$8\frac{1}{5} \times 8\frac{1}{5} \times 2\frac{1}{3}$ feet, about], were placed one within the other and deposited on the stone edge of the sheet of water. We piled fine sand, which had been washed, into the space of 50 centimeters [nearly 20 inches] between the outer wall of the smaller frame and the inner wall of the larger one. The apparatus worked to our complete satisfaction, and the level of the water rose and fell according to the condition of the sea. We scattered inside black spawn of several oysters, and fearing that the elements of nutrition contained in the water and coming from outside should be retained by the sand, thus depriving the captive embryos of their food, we took care to pour into their compartments several times a day several buckets of water taken from the sea when the tide came in. When the collectors were examined two weeks later there was nothing on them, and at the end of a month they were still empty. We were obliged to consider the experiment a failure; but attributed our lack of success to rain, which set in during our operations, and also to the want of heat.

Last year we resumed our experiments. We found ourselves under conditions almost identical with those of the bay of Arcachon. Thanks to the kindness of Mr. Johnston, we commenced new experiments in the vast lagoons of La Teste. In these lagoons the water is not stagnant and oysters are naturally produced there. In the very center of one of the largest sheets of water we constructed two vast basins, measuring 6 to 8 meters [about 20 to 25 feet] square, and working in the same manner as those described above. (See Plate V.) Surrounded by water on every side, infiltration, which constituted the only way of feeding the

basins, was strong enough to make the tide felt in the inside of the basins. During an entire month embryos were thrown in from time to time; even oysters were put inside which were found to have black spawn. And still our collectors showed no sign of spawn.

What is the reason that the eggs and embryos of the *Ostrea edulis*, at least during the entire period of gestation and up to the time when the embryo leaves the maternal shelter, cannot live outside the liquid contained in the shell; and why do they die in pure sea-water? Has it not been observed that the flavor of the water contained within the shells of a common oyster differs from that of the natural sea-water? The former has a peculiar and very agreeable flavor which the latter does not possess. In this difference we thought we could find an explanation, or at least an explanation of part of the phenomenon in question. It appears from an analysis made in the laboratory of M. Berthelot, the result of which we have given in another place, that the water of the oyster (that which had been subjected to an analysis had been taken from spawning oysters) contains, among other substances, a considerable quantity of albumen. It is well known that the sea-water does not contain a particle of that substance. Is the albumen the only substance causing this difference of flavor? We do not know as yet, and new experiments will be necessary to demonstrate it.

We have dwelt at such length on experiments which have only yielded negative results for several reasons: First, because we think that the problem, whose solution we have sought in vain, will one day be practically solved; secondly, because we deem it the duty of every searcher for truth to report what he has seen and observed, in what way he proceeded, and at what final point he arrived in his researches, with the view to facilitate the researches of those who may go in the same direction, thus saving them the useless and disappointing first attempts; thirdly, because, under date of July 15, 1881, we received from Bergen, Norway, a letter addressed to us by Mr. Kjörbo Schmidth, secretary of the Society for the Promotion of the Norwegian Fisheries, in which he advised us that he had succeeded in fixing the embryos of oysters on potsherds deposited on the bottom of the vessel containing these embryos. Although fortune has not favored us like our intelligent and sympathetic competitors in oyster culture beyond the North Sea, we can nevertheless say that we have done all we could. We deem it interesting to give here some extracts from the letter in question.

In the beginning the writer states that the spawn of two mother oysters was placed in a vessel whose water was renewed every day by pouring in a bottle of sea-water. He then goes on to say: "In this vessel even we could notice the influence of the rain and a lower temperature on these small animals. When there was bright sunshine they sported about near the surface; but we had only to lower the curtains at the windows to make them perfectly quiet. If from the sun they

were carried into a cold room without sunshine, they went 2 to 4 centimeters [about 1 inch] below the surface of the water. By letting a fine shower of fresh water fall into the vessel from a sprinkler, the little oysters immediately stopped their movements and went a little below the surface of the water. By continuing the sprinkling, a layer of fresh water formed at the surface, and the little oysters could be seen going down until this layer had reached a thickness of 5 to 6 centimeters [about 2 inches]. At the end of the thirteenth and fourteenth day the shells and potsherds which had been placed at the bottom of the vessel were so thickly covered with young oysters that it would have been difficult to insert a pin anywhere."

We have several times attempted this experiment, following in every particular the directions given in the communication of Mr. Schmidth, but without obtaining any result.*

---

* In a report made to the minister of public instruction, in 1878, we gave an account of experiments similar to those made by General Wergeland in a bay near Christiania, in latitude about 59° north, and stated the following:

It was necessary to counteract the influence of an early and severe winter, of weak tides (which at the most reach the height of only a foot or a foot and a half) and the violent storms which sometimes move masses of water more than 7 feet high. When the winter comes on in Norway, about the beginning of September, the spawn is still too young to resist the great and sudden changes of temperature. It was, therefore, of the utmost importance to keep it from contact with the outer air.

In the upper part of the establishment a reservoir of supply was constructed, filled by a pump worked by a windmill. Immediately below, and inside a shed, which insured protection against the severity of the cold, the spawning basin was constructed, 8 meters long and 6 meters broad [26¼ by 19⅝ feet]. A metal pipe, furnished on the upper side with a fine grating to keep out hurtful animals, and on its lower side with stop-cocks to regulate the flow of the water, connected the two reservoirs. This pipe turned several times on itself, and passed through a chamber filled with water, which could be heated, if necessary, so as to keep at an almost even temperature the water feeding the spawning basin. The level of this basin was regulated by a tube, to the mouth of which was attached a filter destined to prevent the spawn from escaping. In this covered basin the mother oysters, to the number of 2,200, were placed in the beginning of the season; and although they had undergone the fatigue of a long journey, they emitted enough spawn for some of it to be found on the collectors by which they were surrounded.

In addition to this we have to state the following:

M. Bonnasset, an oyster cultivator of Marennes, succeeded two years ago in obtaining some spawn, which had come from some very fine oysters, in a *claire* which he had devoted to this purpose, by placing some mother oysters in a brook which fed this *claire*. The spawn carried along by the current attached itself to shells found at the bottom of the reservoir. This is not a rare occurrence. It has been observed in the pond of Brénéguy, near Auray, where, during the first year the oysters were placed there, a very fine reproduction was obtained, although the water of this pond was renewed only when there was a spring-tide.

A similar occurrence was observed in the ponds constructed by Mrs. Sarah Félix, at Régnéville, when these ponds were first worked. Unfortunately, the harvest reaped under similar conditions is exceedingly uncertain, for it has been observed that oysters living in close waters hardly ever propagate. This is not the case in the *claires* of Marennes, where the oysters regularly fulfil their generative functions, but is so in the two other establishments mentioned above.

There is evidently a time when the embryo is capable of living an independent life, and is liable to attach itself to any body which may resist its course. But when does this time come? Is it when the embryo is expelled from the valves of the mother oyster, or leaves them voluntarily? Or is it necessary that it should first be in the water some time in order to undergo a change and reach a greater degree of completeness? How long does its roving or pelagic life last? All answers to these questions are thus far mere conjectures and suppositions, and the few successful experiments which have been made prove nothing conclusively or even precisely.

In this direction, however, our efforts should principally tend, for it would not matter if the fecundation of the common oyster proved impossible, as long as we could succeed in keeping the legions of embryos which it produces, and cause them to attach themselves to collectors in close waters.*

PARIS, FRANCE, *November*, 1883.

EXPLANATION OF PLATES.

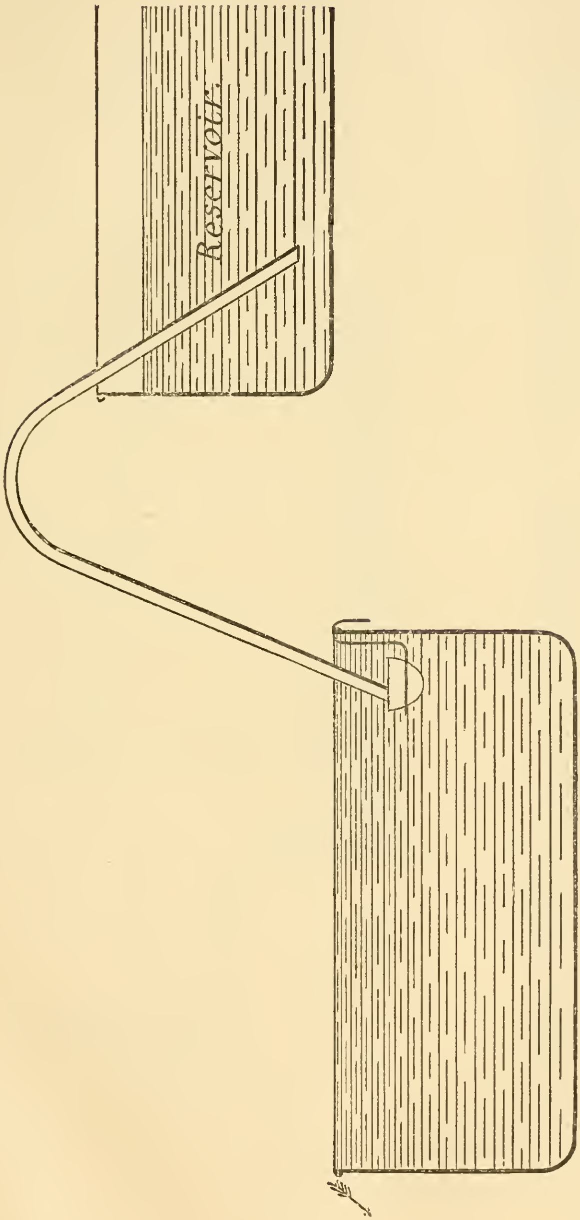
Plate II.—Showing method of working.

III.—1. Supply of water to move the hydraulic wheel.
2. Water-wheel for operating pump.
3. Pump for renewing the sea-water.
4. Distributing pipe receiving the sea-water raised by the pump.
5. Boxes for incubation, hatching, and fixation.
6. Basins containing the mother oysters.

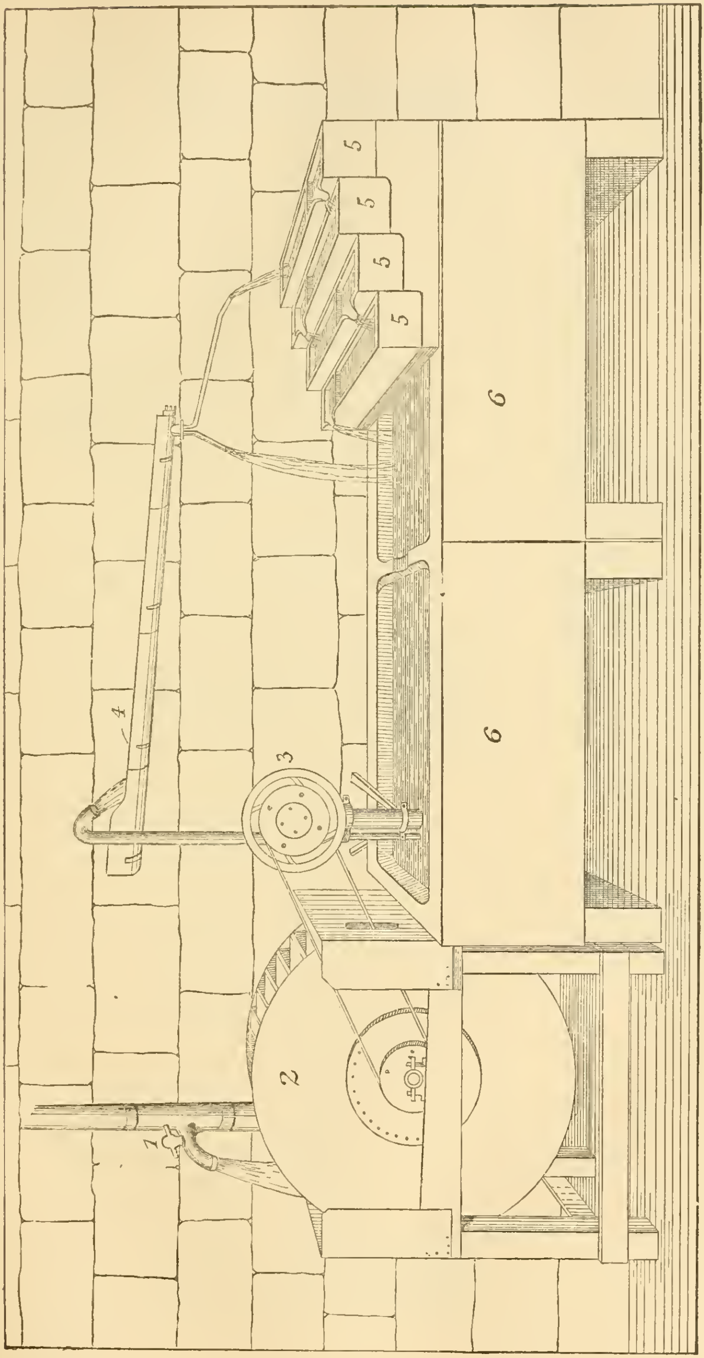
IV.—A. Slate fixed to the bottom and sides of the box.
B. Slate fixed to the sides, and raised about one inch from the bottom of the box.
C. Sand preventing the escape of the embryos.
D. Outflow.

V.—1. Dike of Armaillé.
2. Bay of Arcachon.
3. Aiguillon Point.
4. Board palisades, with holes.
5. Sand for filtering the water.
6. Reservoir containing the embryos.

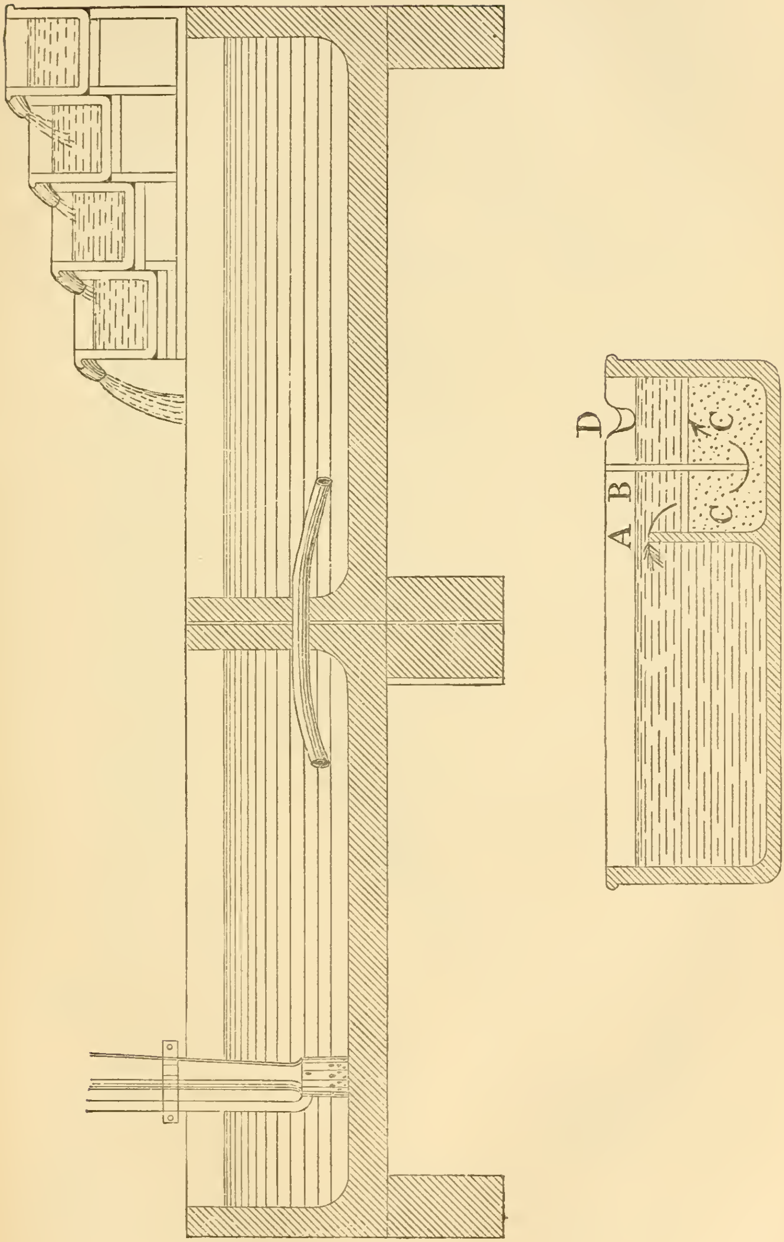
* The quantity of spawn which is lost is truly enormous. Let us take, for instance, the basin of Arcachon, a portion of the coast where the greatest quantity of spawn is gathered regularly, owing to the character of this immense reservoir, to which the sea has access only through a narrow entrance. It is estimated that there are in this basin upwards of a thousand millions of adult oysters, each emitting from 800,000 to 1,500,000 embryos. The annual harvest of spawn is estimated at 1,200,000, that is, nearly one embryo to an oyster; the loss, therefore, is not less than a million to each oyster.



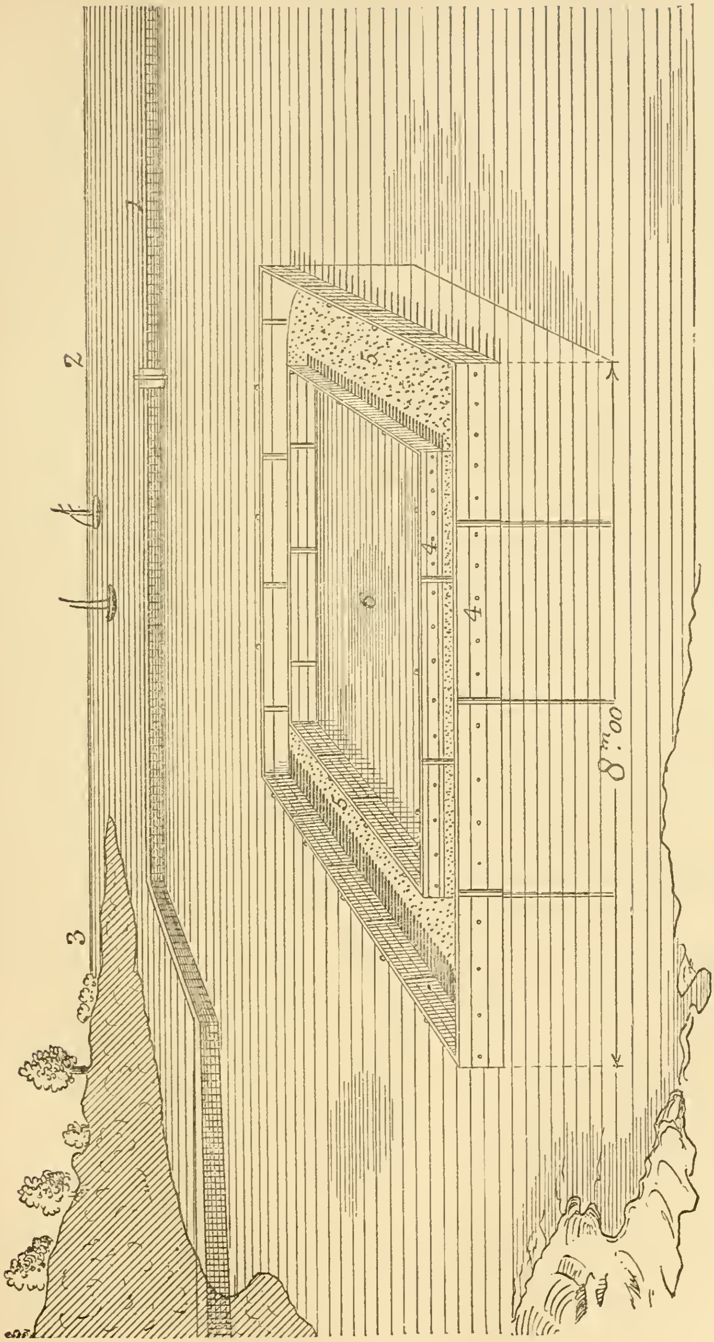
Apparatus for aerating and purifying water containing oyster embryos



Apparatus for incubating and hatching oysters and for the fixation of the embryos.



Sectional views of the basins and hatching boxes.



Experimental *claire* for obtaining oyster embryos in close water.

Vol. VI, No. 16. Washington, D. C. Nov. 2, 1886.

77.—NEW ENGLAND FISHERIES IN AUGUST, 1886.

By W. A. WILCOX.

Of all the leading varieties of food-fish caught by the New England fishing fleet, codfish appears to be the only kind that has been abundant during the present season. On all the leading fishing banks they have been found in great numbers, and receipts have been somewhat larger than for the corresponding month of last year. Vessels from the Grand Banks have all brought in full cargoes. The schooner Henry S. Woodruff, of Lamoine, Me., a three-master, brought home 5,000 quintals, the largest single fare on record. Prices have remained so low that even with full cargoes not much, if any, profit has remained for the fishermen or owners of the vessels.

Mackerel continue to show a large falling off in receipts as compared with the corresponding month of former years. Off the New England coast no body of mackerel has been found. If they have been there they have remained below the surface, and only occasionally have small schools been seen and caught. Many vessels have left the New England coast for the Gulf of Saint Lawrence, meeting with much rough weather, and a large part of the time finding mackerel scarce and the prospect discouraging. The following extracts from reports of masters of fishing vessels and persons on the fishing grounds in the Gulf of Saint Lawrence during the month are reliable and of interest:

GEORGETOWN, PRINCE EDWARD ISLAND, AUGUST 3.—"Boat fishermen have not done anything this season; mackerel are now plentiful, but will not take the hook."

TIGNISH, PRINCE EDWARD ISLAND, AUGUST 5.—"The mackerel fleet remain to the northward; a few local seiners close in shore doing something most every day, but no large hauls. Schools are small; size, fair; not so plentiful off here as a week ago."

MIRAMICHI, NEW BRUNSWICK, AUGUST 8.—"One hundred sail of seiners in this vicinity; schools small, and catch only moderate."

SOURIS, PRINCE EDWARD ISLAND, AUGUST 10.—"No mackerel schooling, and boats make only small catches with hooks; size good and large."

MAGDALEN ISLANDS, AUGUST 10.—"Few mackerel caught about here to date. A recent storm appears to have brought them up, and the prospect improves."

NEW LONDON, PRINCE EDWARD ISLAND, AUGUST 11.—"The fleet are to the north; no fish schooling off here; a light catch the past week."

Harbor au Bouche, Nova Scotia, August 16.—"One hundred sail of seiners are now near West Cape, taking some mackerel. The schools are small and often mixed with herring. The present prospect favors a light fall catch in the Gulf of Saint Lawrence. During the past two weeks the weather has been fine, and by hard work some vessels have done well. Many vessels here five or six weeks have not half a trip. Soon we may expect rough weather, and many vessels will no doubt return with slim fares."

Bay of Chaleurs, August 16.—"No seiners from the United States in this bay, or allowed here. A large fleet last week, between Pigeon Hill and Miscou Point; they took some mackerel. Traps in Chaleurs Bay are doing little, taking from 2 to 5 barrels a day each. Mackerel keep wide out from the shore; none hooked for two weeks."

Souris, Prince Edward Island, August 16.—"Weather stormy; seiners from the United States have had no catch for two weeks; mackerel are close in shore and very wild; boat fishermen not doing much; prices are so low they are leaving the shore."

New London, Prince Edward Island, August 16.—"No catch of mackerel the past week; the weather has been very bad; a gale every day."

Tignish, Prince Edward Island, August 16.—"Weather has been stormy most of the past week; few mackerel seen schooling or caught; not one vessel out of twenty has taken any fish; no catch by shore hookers, as fish do not bite; prospect is poor."

Malpeque, Prince Edward Island, August 18.—"Forty-three sail of seiners are now detained here by high winds; they report mackerel scarce and wild."

Georgetown, Prince Edward Island, August 18.—"The boat fishermen about here have had no catch to date; of late, seiners have had a light catch, and the present prospect is poor; most of the fleet of seiners are at West Cape and North Cape."

New London, Prince Edward Island, August 20.—"Weather is unsettled much of the time; too rough to fish; sixty sail of seiners now in here for shelter."

Port Mulgrave, Nova Scotia, August 23.—"One hundred and seventy-three mackerel seiners now in the Gulf of Saint Lawrence from the United States, and forty-five sail from provincial ports."

Grand Aunce, New Brunswick, August 24.—"Mackerel of large size are now schooling heavy in Bay of Chaleurs. One trap salted 200 barrels the past week. Present prospect is favorable, as fish are plentiful and of good size."

Malpeque, Prince Edward Island, August 26.—"For the past three days one hundred and twenty sail of seiners have been in this port, detained by a strong east wind. No catch of mackerel since the 19th. Remainder of the fleet are at West Cape."

Cascumpeque, Prince Edward Island, August 26.—"Mackerel are wild and in small schools; they keep well off shore. A strong east wind prevents fishing a large part of the time. Some vessels now on the fishing grounds for three weeks and have no fish."

Magdalen Islands, August 27.—"No mackerel being caught about here."

Malpeque, Prince Edward Island, August 29.—"A small catch of mackerel of late; over one hundred sail now in port, detained by high wind."

New London, Prince Edward Island, August 30.—"Weather fine, but no catch of mackerel; we judge the fish have left."

A number of vessels have secured good fares of mackerel in the Gulf of Saint Lawrence during the month, but the fleet in general have taken comparatively few. With the exception of a short time during July that mackerel were freely taken to the north of Prince Edward Island, they have not been found in any abundance off the provincial or United States shores.

The only encouraging feature has been the sharp and steady advance in prices caused by the light catch and poor prospect. Not until the catch, as compared with the corresponding date of 1885, was over 100,000 barrels short, did the price take much of a rise. The first of the month cargo sales in fishermen's order were made at \$4.62½ a barrel; August 9, \$5.87½; August 11, \$6.12½; August 23, \$9.75; August 27, \$10.75; August 30, \$12—on the latter date, fish that were packed and inspected sold for \$9.50 for No. 3's, \$12 for No. 2's, \$16 to \$18 for No. 1's. Prices given being for fish that were caught in the Gulf of Saint Lawrence. Mackerel caught off the New England shore at all times bringing higher prices than from anywhere else: \$11 for No. 3's, \$14 to \$15 for No. 2's, \$20 to \$25 for No. 1's. Extra large bloater mackerel caught off Block Island sold from \$35 to \$40 a barrel.

Receipts of halibut have continued light from most of the fishing banks.

On August 23 the schooner Arthur D. Story, of Gloucester, the first of the Iceland fleet to return, arrived home with 99,000 pounds of halibut; only a partial cargo. The master, Capt. Joseph Ryan, reports that for only a short time after arriving was the weather suitable for fishing. After taking part of a cargo he sailed for Greenland to complete the fare, in hopes of more favorable weather. Leaving Isefiord on July 20 he soon encountered heavy field-ice in Davis Strait, and for three days was surrounded with ice and snow-storms. Being obliged to abandon the attempt to reach the fishing grounds off Greenland by that route he came direct home by way of the Strait of Belle Isle. Calling at several harbors along the Labrador coast and making inquiries for mackerel, he was told that none had been seen this season. The master reports that the winter was fine, and codfish were taken by the natives all winter. May was favorable for halibut fishing, but from that time gales of wind,

with snow-storms, prevailed. The French fleet were having a light catch of codfish. Reports from Norway are favorable, the catch of cod being one of the largest on record.

All halibut brought from Iceland are salted as soon as caught, and on arrival at the home port are smoked before going into the market. Vessels fishing for halibut on the banks nearer home put their catch on ice as soon as caught, and land it fresh. It is then packed with ice in boxes and quickly distributed through the leading fish-markets of the country.

Bait has been abundant all the month, weirs at Cape Cod nearly all the time having abundance of squid or small mackerel, often both. Weirs off the Maine coast have had a good catch of herring, more than was wanted by the fishermen.

Number and location of the New England fishing fleet during the last week of August.

Location.	Object.	No. of vessels.
Grand Banks, lat. 44° to 46°, long. 52° to 54°	Codfish	80
Grand Banks, lat. 44° to 45°, long. 49° to 51°	Halibut	25
Banquereau, lat. 44° to 45°, long. 58° to 59°	...do	15
Between George's and Brown's Banks	...do	15
George's and Brown's Banks, lat. 41° to 43°, long. 66° to 68°	Codfish	225
In Gulf of Saint Lawrence	Mackerel	175
Off the New England coast	...do	75
Off the New England coast	Ground fish	290
On the way home from Iceland	Halibut	6
Off the New England coast ...steamers	Whales	3
In Gulf of Saint Lawrence ...steamer	Mackerel	1
Total		910

Receipts of fish at Gloucester, Mass., in August, 1886.

From—	Fares.	Codfish.	Halibut.	Hake.	Haddock.	Cusk.	Pollock.	Swordfish.	Mackerel.	Menhaden oil.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Bbls.*	*Bbls.*
George's Bank	142	2,906,000	273,713	5,000		5,000		2,530		
Brown's Bank	19	702,000	1,450				2,000			
Banquereau	7	80,000	112,000							
Bay of Fundy	9	103,000	150	35,000				12,573		
Grand Banks	34	3,010,000	432,200							
New England shore	9	83,000		32,000	7,000		2,000	265		
Flemish Cap	2	570,000	15,000							
La Havo Bank	9	289,000	57,000			7,000				
Nova Scotia, Cape shore	4	165,000		15,000						
Iceland	1		99,000							
Off Newfoundland	1		12,000							
Western Bank	6	339,000	46,800	15,000						
Off Seal Island	7	223,000	2,500				4,000			
Gulf of Saint Lawrence	27								11,525	
Off New England shore	4								122	
Tiverton, R. I.	1									800
From small boats		12,000		39,000						
Total in August, 1886	282	8,482,000	1,051,813	141,000	7,000	12,000	8,000	15,368	11,647	800
Total in August, 1885	414	7,122,000	1,112,950	69,000	42,000	39,000		70,345	48,237	700

Additional receipts from Maine in August, 1886: 15,000 boxes of smoked herring, 600 quintals of dry hake, 88 barrels of cod oil.

Mackerel landed by the New England fleet, in sea-packed barrels, at all ports, was as follows:

Time.	1885.	1886.
Up to August 1	116,836	19,112
Week ending August 7	40,150	1,849
Week ending August 14	18,363	10,381
Week ending August 21	18,584	1,118
Week ending August 28	19,066	2,031
Three days ending August 31	10,153	2,812
Total to September 1	223,152	37,303

Whaling fleet of Provincetown, Mass., August 13, 1886.

Name.	Net tonnage.	No. of boats.	No. of men.	Location of whaling grounds.
Schooner William A. Grozier*	111.09	2	16	Atlantic Ocean.
Brig David A. Small†	113.83	2	16	Do.
Schooner Quickstep†	89.25	2	16	Do.
Schooner Ellen Rizpah †	63.43	2	16	Do.
Schooner Mary G. Curren †	97.03	2	16	Do.
Schooner Rising Sun †	65.99	2	16	Do.
Schooner Agato †	76.95	2	16	Do.
Schooner Antarctic †	95.57	2	16	Do.
Schoonor Baltic †	76.81	2	16	Do.
Schooner Bloomer †	70.13	2	16	Do.
Schooner Alcyone ‡	87.61	2	16	Do.
Schooner Gage H. Phillips †.	101.37	2	16	Do.
Steamer Angelia B. Nickerson	26.97	....	6	Off New England coast.
Total	1,076.03	24	198	

* Arrived on August 9. † Now on voyage. ‡ Arrived June 14; now on second voyage.

GLOUCESTER, MASS., *August* 31, 1886.

78.—HAWAIIAN FISHING IMPLEMENTS AND METHODS OF FISHING.

By Mrs. EMMA METCALF BECKLEY,

Curator of the Hawaiian National Museum.

[Abstract.]

The Hawaiians have five methods of fishing: by spearing, hand-catching, baskets, hook-and-line, and with nets.

The spearing of fish is of two kinds, below and above water. That below water is the most important, and is generally employed for the different kind of rock fish. The spear used by the diver is a slender stick of from 6 to 7 feet in length, made of very hard wood, and sharply pointed at one end, but more tapering at the other. Since the possession of iron, spears are always tipped with it, but perfectly smooth, without hook or barb. Diving to a well-known station by a large coral rock or against the steep face of the reefs, the diver places himself in a half crouching position on his left foot, with his right foot free and extended behind, his left hand holding on to the rock to steady himself,

and there he watches and waits for the fish. Fish in only two positions are noticed by him, those passing before and parallel to him, and those coming straight towards his face. When the fish is hit, the force of the blow generally carries the spear right through to the hand, thus bringing the fish up to the lower part or handle of the spear, where it remains while the fisherman strikes rapidly at other fish in succession should they come in a train, as they usually do.

Except in the case of "oopuhue" spearing, above-water spearing is very rarely used, and then generally in connection with deep-sea line-and-hook fishing. "Oopuhue" is the well-known poison fish of the Pacific, but is of a delicious flavor. It is generally speared in inclosed salt water ponds from the stone embankments. The poison of this fish is contained in three little sacs, which must be extracted whole and uninjured. The fish is first skinned, as the rough skin is also poisonous in a slight degree. Should the teeth of the fish be yellow, then it is so highly charged with poison that no part of its flesh is safe even with the most careful preparation. "Oopuhue" caught in the open sea are always more poisonous than those from fish ponds.

Some fishermen dive to well-known habitats of certain fish and lobsters and, thrusting their arms under rocks or in holes, bring out the fish one by one and put them into a bag attached for the purpose to the loin cloth. Women frequently do the same in shallow waters, and catch fish by hand from under coral projections. It is also a favorite method employed by women in the capture of the larger varieties of shrimps and "oopus" in the fresh-water streams and "kalo" ponds. Goldfish are also caught in that way, and at the present time form no inconsiderable portion of the daily food of the poorer classes living near "kalo" patches or fresh-water ponds. Their power of reproduction is very great. The different kinds of edible sea-slugs are caught in the same way, although the larger kinds are sometimes dived for and speared under water.

There are two ways of octopus fishing. In shallow water the spear is used. Women generally attend to this. Their practiced eye can tell if an octopus is in a hole whose entrance is no larger than a silver dollar, and plunging their spears in they invariably draw one out. These mollusks have the peculiar property of drawing themselves out and compressing their bodies so as to pass through very narrow apertures many times smaller than the natural size or thickness of their bodies. Those caught in shallow waters vary from 1 to 4 feet in length, but the larger kinds live in deep water always and are known as blue-water octopus.

They are caught with cowries of the *Mauritiana* and sometimes of the tiger species. One or more of these shells is attached to a string with an oblong pebble on the face of the shell; a hole is pierced in one end of the back of one of the shells through which the line is passed, which, having been fastened, is allowed to project a few inches

below, and a hook whose point stands almost perpendicular to the shaft or shank is then fastened to the end of the line. Only the finest kind of *Mauritiana* or tiger cowries are employed for this purpose, as the octopus will not rise to a large-spotted or ugly one. The spots on the back must be very small and red, breaking through a reddish-brown ground; such a shell would have the strongest attractions for an octopus. Cowries with suitable spots, but objectionable otherwise, are slightly steamed over a fire of sugar-cane husks. This has the effect of giving them the desired hue.

The fisherman having arrived at his fishing-grounds first chews and spits on the water a mouthful of candle-nut meat which renders the water glassy and clear; he then drops the shell with hook and line into the water aad swings it over a place likely to be inhabited by an octopus. This being a voracious animal, when in its hole is always, according to Hawaiian fishermen, keeping a lookout for anything eatable that may come within reach of its eight arms. The moment a cowry is perceived, an arm is shot out and the shell clasped; if of the attractive kind, one arm after the other comes out, and finally the whole body is withdrawn from the hole and attaches itself to the cowry, which it closely hugs, curling itself all around it. It remains very quiet while being rapidly drawn up through the water, till, just as its head is exposed above water it raises it, when the fisherman pulls the string so as to bring its head against the edge of the canoe and it is killed by a blow from a club which is struck between the eyes. This must be done rapidly, before the animal has time to become alarmed and let go the cowry, when, should the arms be a fathom in length, it becomes a dangerous antagonist, as there would be risk of the fisherman being squeezed to death. Having eight arms, an octopus of such a size could very well manage two or three persons, as the cutting off of one or more of its arms does not affect the rest in the least.

Torch-light fishing is practiced on calm dark nights. The fish are either caught with small scoop-nets or are speared. Torch-light fishing is always done in shallow water where one can wade. The fisherman must be spry and light of step, passing through the water without a splash to disturb the fish, which remain quiet, as if dazzled by the light unless alarmed by the splashing or concussions in the water. The torches are made of split bamboos secured at regular intervals with leaves, or of twigs of the spurious sandal-wood bound together in the same manner.

The Hawaiians have four kinds of basket fishing. The first is with a basket looking something like the coal-scuttle bonnets of a hundred years ago, and is woven with the air roots of the *Freycinetia arborea*. This is used for mountain shrimping, and women always attend to it. They move in a crouching position through the water, moving small stones and thrusting sticks under the large ones to drive the shrimps to a suitable place which is always some place where the grass, ferns, or

branches of trees droop over on the water; the shrimps take refuge in or under these and the fisherwoman places her basket under the leaves and lifts them out of the water, when the shrimps drop into the basket; she then unties the small end and drops them into a small-mouthed gourd attached to a string, which she keeps floating after her for that purpose, and puts some fern leaves inside the gourd to keep the shrimps from creeping out, as they are lively little fellows living a long time out of water and scampering about on land like cockroaches.

The second is with a small basket made from the vines of the convolvulus, and it is renewed from day to day as wanted. A light framework of twigs is first tied together and then the vines, leaves and all, are wound in and out, round and round, till of the requisite size, 3 or 4 feet in circumference and about 1½ in depth. Shrimps pounded and inclosed in cocoa-nut fiber are occasionally placed at the bottom of the basket for bait, but usually the scent of the bruised and withering leaves seems to be sufficient. Women always attend to this kind of fishing. They wade out to suitable places, generally small sandy openings in coral ground or reef, and let the baskets down suitably weighted to keep them in position, the weights being attached in such a way as to be easily detached. Each woman then moves away from her basket to some distance from which she can watch the fish enter the basket. When all the fish that are in sight have entered, she takes the basket up and transfers the fish to a large small-mouthed gourd, and moves the basket to a fresh place.

Fishing in this way can be carried on only during a calm sunny day and at low tide. Since the introduction of the weeping-willow, baskets for this fishing are sometimes made of willow twigs. Such can be used over and over again. Men sometimes take such baskets and using sea-eggs for bait, with the top of the shell broken to expose the meat, place them in comparatively deep water, piling stones around them to keep them in place. They leave them thus for a day or two, and if the place is a good fishing-ground the basket will be full by the time they come for it.

The third kind of basket is shallow, of about the same size as the above but wider mouthed, used in deep water for catching a small, flat fish called "uini" that makes its appearance at intervals of from ten, fifteen, or twenty years. At the last appearance of the "uini," the imported marketing baskets were generally used by those who could not obtain the old-fashioned kind, as any old cast-away basket would do, with a little patching occupying perhaps five minutes, and two sticks bent over the mouth or opening from side to side and at right angles to each other for a handle to which to tie the draw-string. It should be twisted round and round above the jointure with a little of the sea convolvulus with the leaves on, so as to throw a little shade into the basket to keep the fish from being frightened while they are being drawn up to the surface of the water. In these baskets cooked pumpkins, half-roasted

sweet potatoes, or raw ripe papayas were placed for bait. The canoes thus provided would sail right into the midst of a school of these fish; the basket being lowered a few feet into the sea, and the fish being attracted by the scent of the bait, would rush into the baskets and feed greedily. As soon as the baskets were full of fish they would be drawn up and emptied into the canoe and then lowered again, with more bait if necessary, and this would go on till the canoe was loaded or the fishermen were tired. These fish are very good eating when they first arrive, as they are fat, with the liver very much enlarged; but after a month they become thinner, not perhaps procuring their proper food here, and then taste strong and rank.

The fourth kind of basket is the largest kind used in fishing by the Hawaiians. These are round, rather flat baskets, 4 to 5 feet in diameter by 2½ to 3 in depth, and about 1½ across the mouth. A small cylinder or cone of wicker is attached by the large end to the mouth and turned inward towards the bottom of the basket. This cone or cylinder is quite small at the free end, just large enough for the fish ("kala") to get in. Immediately below the end of this cone, on the bottom of this basket, is placed the bait, properly secured, which is a coarse, brownish-yellow alga, on which this fish feeds and from which it takes its name, ripe bread-fruit, cooked pumpkins, half-roasted sweet potatoes, and papayas. The fishermen generally feed the fish at a given place for a week or more before taking any, using for this purpose a large basket of the same kind, without the inverted cylinder and wider in the mouth, to allow the fish free ingress and egress. After a week or two of feeding they become very fat and fine flavored, as also very tame, and baskets full of fish can be drawn up in the taking basket without in the least disturbing those that are still greedily feeding in the feeding baskets. These baskets are occasionally used for other kinds of fish, substituting the bait known to attract that particular kind.

The Gilbert Islanders have of late years introduced fishing with a basket in a manner different from any formerly practiced by Hawaiians. This is an oblong basket, called by these people a "punger," larger at one end than another, with a flat and oval top, convex like a carriage top, and gradually sloping to the small end. A cone with the end cut off is inserted at the large end, the body of the cone being inside of and opening into the basket. A trap-door is fixed on the end of the cone in such a manner that it will open by a touch from the outside, but cannot be pushed open from the inside. The basket is taken to a good, sandy place, in 2 to 4 fathoms of water, where there is plenty of coral or stones handy. The fisherman then dives and places the basket in the exact position he wishes; he then takes pieces of coral rock and begins to build up and around the basket, inclosing it completely with stones so as to form an artificial dark retreat for the fish. The entrance to the cylinder or cone is left exposed, and the fish, seeing an inviting entrance to a dark place, go on an exploring expedition till they find

themselves inside. Once inside they cannot return. This basket is left from two days to a week in a position at the bottom of the sea, when the stones are displaced, the basket and its contents are hauled up to the canoe or boat, a door left at the smaller end of the basket is opened, the fish shaken out, and the basket is ready to be replaced in the sea.

There are only seven kinds of fish sought for in fishing with rod, hook, and line. The bait most liked is shrimp; earthworms are sometimes used and any obtainable fry of fish. The fisherman takes a handful of shrimps, baits his hooks, and then, bruising the remainder and wrapping it up in cocoa-nut fiber, ties it with a pebble on the line and close to the hooks; the bruised matter spreads through the water when the line is dropped and serves to attract fishes to the vicinity of the hooks.

For hook-and-line fishing practiced in deep water, bonitos and lobsters are the usual bait; for lack of these any kind of fish is used with varying results. For deep-sea fishing the hook and line are used without rods, and our fishermen sometimes use lines over 100 fathoms in length. Every rocky protuberance from the bottom of the sea for miles out, in the waters surrounding the islands, was well known to the ancient fishermen, and so were the different kinds of rock fish likely to be met with on each separate rock. The ordinary habitat of every known species of Hawaiian fishes was also well known to them. They often went fishing so far out from land as to be entirely out of sight of the low lands and mountain slopes, and took their bearing from the positions of the different mountain peaks, for the purpose of ascertaining the rock which was the habitat of the particular fish they were after.

The natives distinguish the sharks seen in Hawaiian waters into five species: The "mano-kihikihi" (hammer-headed shark) and the "lalakea" (white fin) are considered edible, as the natives insist that these never eat human beings; then comes the "mano-kanaka" (man shark), which only rarely bites people; then the "mano," a large white shark, the largest of all known to Hawaiians, but not a particularly ravenous one, which is seldom seen; the "niuhi" completes the list, a very large shark, and the fiercest of all, which, fortunately, very rarely makes its appearance in Hawaiian waters.

There are two general divisions of the kinds of nets in use here, the long nets and the bag or purse nets, with endless variations of those two main features. The finest of the long nets has a mesh one-half inch wide. It is generally 1½ fathoms in depth and from 40 to 60 fathoms in length. It is used to surround and catch the small mullets and "awas" in shallow waters for the purpose of stocking fish ponds. Small pebbles, frequently ringed or pierced, are used for sinkers and pieces of the *Hibiscus tiliaceus* and candle-nut tree for the floaters. Nets of 1 to 2 inch mesh are used for the larger mullets. A 2 to 2½ inch gill-net is sometimes stretched from a given point to another at high tide, and always across what they call fish-runs in shallow waters, which are

long, sandy openings in coral places. Two persons, or sometimes one, work this net, passing backward and forward to seaward of the net, taking out fish as fast as caught in the meshes. This way of fishing is only practiced at night. Sometimes a place where fish are seen or are likely to be is surrounded and the water inside the circle beaten, when the frightened fishes dart in every direction with great violence and are meshed.

A long net of 3 to 4 inch mesh is used for catching large fish, such as the "oio." It is of 80, 100, 140, or even 150 fathoms in length by 2 to 3 fathoms in depth. It is used in the deeper waters just inside, or in shallow waters just outside, the reef or breakers. For this fishing the fishermen go in canoes; one man is always standing upright on the cross-bars of the canoe, keeping a sharp lookout for a school of "oio." When he sees one, the canoes follow it at a distance from place to place, or wait patiently, if the fish remain in an unfavorable place, till they move into the accustomed fishing-grounds. Two or three canoes are almost always engaged together in this kind of fishing. When the fish are in a suitable place one canoe approaches very cautiously and stations itself where the net is to be dropped, while another one, carrying a net of the same kind, makes a wide curcuit till immediately opposite, with the fish between, when the ends of the nets are dropped simultaneously from the two canoes, and both paddle in a semicircle while paying out the net and striving to meet the dropped ends of the opposite net as soon as possible, so as completely to inclose the school before the fish become alarmed. The first canoe having met the end of the opposite net, if on sandy bottom, keeps on one side of the net already down, drawing its own net after it, thus gradually reducing the circle, as well as making two or three rings of netting around the fish, so that if they make a rush to any given point and by their weight bear down the floaters, those escaping from the first circle will still be inclosed by the outer ones, and eventually be caught by becoming entangled and meshed. When the nets have been drawn to suit the head fisherman they all jump overboard with their canoe poles and by beating the water frighten the fish, which dash here and there with great violence, entangling themselves in the nets, and are easily captured.

In catching other kinds of fish these or smaller nets are used either in daylight or at night, though the best results are almost always obtained at night. The nets are dropped in a semicircle and some of the fishermen, making a wide sweep to the opposite side, spread out fan-shape and move rapidly towards the net, beating the water as they go with their arms, and thus driving the fish from quite a distance into the comparatively small area partly inclosed by the nets, while the two men holding the stick supporting the end of the net and standing perpendicularly in the water run towards each other on the approach of the beaters. Should the water be dirty and the net rather long, the ends are then gathered together until the circle is all reduced and the fish

all taken. If at night, numbers of rock fish are also taken with those that spread in schools.

The finest of all kinds of nets ("nae") has only one-fourth inch mesh. The "pua" net is for young mullet fry for stocking ponds or for eating. This net is generally a piece, a fathom square, attached on two sides to sticks about 3 feet in length and fulled in, the bottom rope being shorter than the upper one and forming an irregular square opening to a shallow bag, which is supplemented by a long narrow bag about 3 or 4 inches wide and 2 feet deep. The sea convolvulus, generally found growing on the beach, is twisted, leaves, branchlets, and all, into two thick, bushy ropes some 15 or 20 feet in length, and these are attached on each side of the net to the side sticks; these lines are then drawn forward in a semicircle sweeping the shoals of fry before them till enough are partly inclosed, when the two free ends are brought rapidly together in a circle, which is gradually reduced, the same as in long-net fishing, till the fry are all driven into the bag.

The same size of mesh ($\frac{1}{4}$ inch); but made into a much larger bag, is used in fishing for "ohua," a small kind of fish very highly prized by the natives, which lives in and feeds upon the coarse alga that grows on coral in shallow water. Long ropes, 100, 200, or even 300 fathoms in length, having dry "ki" leaves braided on them by the stems, the blade ends of the leaves hanging loose, are started from a given place in opposite directions to sweep around and finally inclose a circle, which is afterwards reduced in the same manner as in long fishing. Great numbers of men, women, and children assist at this kind of fishing to hold the ropes down to the bottom, and by the splashing and disturbance of the alga drive the fish away from the ropes and into the net. Persons are generally stationed every yard or so on the ropes for this purpose and also to disentangle the ropes if caught on a rock or other obstruction. When the circle is narrowed to from 10 to 15 feet in diameter one end of the ropes is untied and the ends attached to the ends of the side sticks of the bag-net, forming a guard on each side, and the circle further reduced till the fish are all driven into the net.

The diver's net is a small bag of 2-inch mesh, about $2\frac{1}{2}$ feet across the opening or mouth of the bag and the same in depth. Two sticks are attached on each side of the opening, leaving a space of half a foot in width between them. This net is managed by one person, who dives to the small caves and holes at the bottom of the sea, which are always well known to the local fishermen, and placing his net across the opening or hole, mouth inwards, he then inserts a slender rod, with a tuft of grass at the end, into the hole, and gently drives the fish which may be in there into the open mouth of his net, which he closes by joining the two sticks together. Then placing his driving stick over the closed mouth as a further preventive, he rises to the surface, and emptying his bag into the canoe, goes to another cave or fish-hole, where he repeats the operation till tired or satisfied with the quantity caught.

Another net is for catching "uhu," a very highly prized kind of rock fish of two species, the red and the green. The red varieties are the more choice ones for eating raw. The green are not so fine flavored, but attain a larger size. The net for these fishes is a square of 2 or 3 inch mesh, which has been slightly gathered on the ropes and attached at the four corners to slender strong sticks tied together at the middle in such a way that they will cross each other at the middle and can be closed together when wanted. When crossed they spread the net open in the form of a shallow bag, a string is tied to the crossing of the two sticks, and the net is then ready for operations. A decoy fish, which may have been previously caught with the hook and line, is then dropped, with a string attached, in a place where fish of that kind are noticed or known to frequent, and gently moved back and forth; this is called "teasing the fish." Every fish of that kind which can see the decoy fish is immediately attracted to see the strange actions of this one, and when all have been attracted that are likely to be in the vicinity the net is gently dropped at a little distance from the decoy, which is then gently drawn into the net. All the fish rush after it into the net, which is then quickly pulled up, the sticks bending over, which elongates the bag, also reducing the opening or mouth. By a peculiar twitch and pull on the string the sticks can be made to swing around and lie parallel, thus effectually closing the bag. No diving is required for this net beyond that which is sometimes necessary to get the decoy. It is also used for several other kinds of rock fish of like habits, always first getting a decoy of the kind wanted. Fishermen almost always carry for this kind of fishing candle-nut or cocoa-nut meat, which they chew and spit over from time to time to smooth the sea so that they can observe the bottom.

The "opule" is taken in a similar manner in a bag-net, a fathom in length, having a small oval mouth 2 or 3 feet wide.

A large 1-inch mesh net, 8 fathoms in depth, is used in deep waters for catching the Hawaiian mackerel, a small narrow fish caught only at certain seasons. Cooked pumpkins are placed at the bottom of the net for bait, and lowered some fathoms beneath the surface, and the scent of the pumpkin diffusing through the water attracts the fish and they enter the bag to feed on it. When a sufficient quantity of them have entered it is rapidly drawn up and emptied of fish. More pumpkin is put in, and the fishermen sail to a fresh place to drop the bag.

Two other nets are used for two kinds of very small fish that come at certain seasons in immense schools and are much used for bait. Pickled and dried they are very good eating. The net is a fine-mesh bag exactly like a "pua" net, but much larger. It is to be used with ropes with "ki" leaves attached, only this sort of fishing net requires no diving, as it is used in deep waters.

In another kind of decoy fishing the decoy used is a billet of hard wood something like a club, rounded at the ends and one end smaller

than the other, with a little ringed knob on the smaller end to tie a string to. This club, when prepared with the proper attention to the usual lucky or unlucky superstitions common to Hawaiian fishermen, is then slightly charred over a regulation fire. "Kukui"-nut meat and cocoa-nut in equal quantities are first baked, pounded, and tied up in a wrapping of cocoa-nut fiber (the sheath around the stem of a cocoa-nut leaf), and the fishermen then start on a canoe for the fishing-grounds. This should be in water not deeper than 4 or 5 fathoms. Arrived there the decoy is then greased with the oily juice of the pounded nuts and dropped overboard and allowed to hang suspended a few feet from the bottom. The scent of the baked nut meat diffusing through the water seems to have a powerful attraction for some kinds of fish, which surround the stick, seeming to smell or nibble at it. After awhile the bag-net is dropped over with its mouth open towards the stick, when the latter is moved gently into it, the fish still surrounding and following it into the net. Two persons then dive and, approaching the net gently, quickly close its mouth and give the signal to those in the canoe to haul it up.

The "hano" is a large bag net of very fine mesh, with a flaring mouth, used to capture flying-fish. There are two varieties of flying-fish here, entirely distinct from each other. The same net and method of capture is also employed for the "iheihe," a long thin fish, usually 1½ feet in length, with a very sharp-pointed snout, that generally arrives here at about the same time as the large flying-fish. The "hano" is also occasionally employed for the "akule," another fish that arrives in schools.

For catching the large flying-fish the "hano" is piled on a double canoe or large single one, and a start is made early in the morning with an attending fleet of from twenty to forty canoes. Women very often go in this kind of fishing to help paddle the canoes, as no particular skill is called for on the part of the general hands, the success of the fishing depending altogether on the good judgment and sight of the lookout. This person is generally on a light canoe manned by only two or three hands, and he is standing up always on the cross-ties of the canoe looking for the fish. Whenever he discerns a strong ripple he points it out to the rest of the canoes, who then surround the spot indicated while he confers with the head fishermen about the best place to drop the net, which depends upon which way the current sets. When the net is all ready the canoes paddle very quickly in towards it, splashing the water and driving the fish before them into the open net.

It seems that these fish will not dive to any depth, and are always found swimming very near the surface, so that, when completely surrounded by canoes, they can be driven wherever wanted. The fleet very often goes several miles out to sea; and this fishing is called "blue-sea fishing."

The "kolo" is the largest of all the nets, and can be used only in a very few places, like the harbor of Honolulu, Puuloa, &c. It is an im-

mense bag from 16 to 24 fathoms in depth, small-meshed and narrow at the extreme end, but widening out into an immense flaring mouth, with long nets 16 to 20 fathoms deep attached on each side and called its ears. This is swept from one side to the other of the harbor, scooping up every kind of fish. A great many sharks 6 feet in length are sometimes caught in it, but the net is generally used when the mullet is in roe and is designed for the capture of large quantities of that fish. It requires a great many hands to manage it.

A large bag-net, somewhat smaller than the "kolo," but of the same general shape, is sometimes used. Two ropes of 300 or 400 fathoms in length, with "ki" leaves attached, and generally the rope of two or more "ohua" nets joined, are piled on to a large double canoe, which is taken out 2 or 3 miles from shore, attended by a fleet of from sixty to one hundred canoes. The head fisherman always goes on the canoe containing the net and ropes. Arrived at the proper distance, which must be just opposite the final drawing place, the end of one rope is joined to that of the other, and two canoes, manned by eight or ten strong men, take the other end of the rope, one each, and start in opposite directions and exactly parallel with the shore, while the double canoe remains stationary till all the rope is paid out. In the mean time the rest of the canoes have divided into two companies and follow the two leading canoes, stationing themselves at certain distances on the rope and helping to pull it. When the rope is all paid out, the two leading canoes then curve in to form a semicircle, at the same time always moving towards the shore. When a perfect semicircle has been made by the rope the double canoes and all the others move gradually forwards with it, while the leading canoes are pulling with all their might straight in to the shore. When either end is landed the men immediately leap out and taking hold of the line pull on it, at the same time going towards each other, which has the effect of narrowing the semicircle, while most of the canoes keep backing on to the double canoe, which always keeps the center. Arrived at a suitable place, which is always a clean sandy one a few rods from shore, the ropes are untied and attached to each end of the net; men, women, and children now gather on the rope, especially where it joins the net, and make a great disturbance with their feet, which drives all the fish into the net. Rope and net are finally drawn ashore.

We have two kinds of fish ponds or inclosures: Fresh-water ones, from half an acre to 2 or 3 acres in extent; and salt-water ponds, generally very large and inclosing an area of many acres. The salt-water ponds are of two kinds—those entirely closed, and in which fish are fed and fattened; and those surrounded by a low wall that is submerged at high tide and has openings, which are walled on each side like lanes leading in or out of the pond.

The lanes, or fish-runs, are from 15 to 20 feet in length and radiate from the wall inside and out. They are of about 2 feet in width at the

opening in the wall and widen out gradually till they are from 8 to 10 feet wide at the ends. At night when the tide is coming in, a man, or more frequently a woman, takes a small scoop-net just wide enough to fill the entrance of the opening and of 3 or 4 feet in depth, wades out to the entrance of one of these runs, and sitting on a raised stone platform on its side, made for that purpose, holds the net in the water at the entrance of an opening towards the sea and sits very quiet until a jerk in the net is felt, when it is immediately pulled up before the fish have time to return, and the fish are dropped into a gourd or basket, when the net is immediately returned to the water and waiting and watching are resumed. Two persons generally go to this kind of fishing and sit on opposite sides of the entrance, so that as one net is raised another one is still there, as under certain conditions of the water and weather two persons will be kept busy scooping up fish as fast as the nets can be lowered. No fish must be allowed to get free as that would put a stop to the fishing at that entrance during that turn of the tide.

These entrances are favorite stations for the ground-sharks of the neighborhood to prey on the fish as they go in or out, and so when the tide is about medium height the fishing people return to shore, as their platforms would be entirely submerged at high tide. At the turn of the tide, and when the platforms are exposed, other parties take their turn at the lanes, using those with entrances opening inwards. These fish ponds are sometimes owned by the proprietors of two adjoining lands, the people of one owning the right to fish during the rise of the tide and the other during the ebb. Long nets are also used in these ponds, but only during the condition of the tide belonging to each.

The large salt or brackish water ponds, entirely inclosed, have one, two, or four gates. These are of straight sticks tied on to two or three cross-beams, the sticks in the upright standing as closely as possible, so that no fish half an inch in thickness can pass them, while the water and young fry can pass freely in and out. Scoop-nets the width of the gates are used at these places at the flow of the tide to scoop up such fish as may be desired by the owner or pond-keeper for family use. When any large quantity is wanted the long net is used, the same as in shallow-sea fishing.

Fresh-water ponds are very seldom over half an acre in extent, and are for "oopu" and "opae" preserves, and sometimes for "awa," a kind of tropical salmon that breeds in brackish water and will live and grow fat in perfectly fresh water. The young fry of this fish are procured in shallow waters on the beach where a stream or spring of fresh water mingles with the sea, and are carried sometimes many miles inland in large gourds with water.

The catfish has been introduced within four years, and is doing well. Carp have also been introduced very recently, but it is yet too early to pronounce on the success of the experiment.

HONOLULU, *June* 25, 1883.

Vol. VI, No. 17. Washington, D. C. Nov. 8, 1886.

79.—AMERICAN CATFISH IN THE TROCADÉRO AQUARIUM OF PARIS.*

By Dr. JOUSSET DE BELLESME.

These fish,† which measured 12 centimeters [about 4¾ inches] in length, were in the beginning, owing to their small size, placed in one of the tanks for young fish in the aquarium, and remained there till November, 1885, when they were put in the large basin No. 6.

They were at first fed with raw meat; but as they did not seem to take very well to this kind of food, they were fed on raw fish chopped fine, which they appeared to like. As soon as they were transferred to the large basin they were fed on live fish.

The only water at the disposal of the aquarium is that which comes from the Vanne, whose temperature is 15° C. [59° Fahr.] in August and 9° C. [48.2° Fahr.] in December. It is hardly probable that this temperature is sufficiently high for the reproduction of the catfish. At any rate, those which we have in our aquarium, no matter to what variety they belong, have never spawned.

When the American catfish were transferred to basin No. 6 they were all alive and well, although they had not grown perceptibly. Since that time none of them have died, as far as we have been able to observe, for these fish have a habit of keeping in their holes and never coming out during the day, so that they are hardly ever seen. In basin No. 1 we had some of considerable size, and in order to assure ourselves of their existence it became necessary to empty the basin and carefully search for them at the bottom in the cracks between the rocks. Even then we did not always succeed in finding them. I have therefore reason to believe that the seven catfish which the Acclimatization Society has given us are still in existence, and the first time the basin is emptied I will search for them again in order to make sure of it.

I should state that the Trocadéro aquarium is by no means adapted to researches of this kind. The impossibility of varying the temperature of the large mass of water which feeds it prevents us from successfully reproducing any other fish but salmonoids. Moreover, our basins are too large for small fish, which easily escape observation.

PARIS, FRANCE, *May* 28, 1886.

* "*Catfish dans l'aquarium du Trocadéro, Paris.*" From the *Bulletin mensuel de la Société Nationale d'acclimatation de France*, Paris, August, 1886. Translated from the French by HERMAN JACOBSON.

† For note on their receipt see Fish Commission Bulletin for 1886, p. 138; also Fish Commission Bulletin for 1885, p. 433.

80.—FRY PLANTED IN RIVERS OF BELGIUM IN 1886.*

[Extracted from the report of the Commission on Fish-Culture to the Minister of Agriculture, Industry, and Public Works.]

The plantings of fry made in 1886 in the tributaries of the Meuse River have been entirely successful. The following has been the extent of these operations:

Fry were planted as follows:

Kind.	Number.
Salmon (*Salmo salar* Lin.)	63,000
Trout (*Trutta fario* Lin.)	217,000
Lake trout (*Trutta lacustris* Lin.)	30,000
Thymallus vexillifer Ag	30,000
Salmo salvelinus Lin	12,000
Total	352,000

They were distributed as follows:

Where distributed.	Kind.	Number.
River Semois and tributaries	Trout	51,000
Do	*Thymallus vexillifer*	9,000
River Lesse and tributaries	Salmon	6,000
Do	Trout	57,000
Do	Lake trout	12,000
Do	*Thymallus vexillifer*	9,000
River Molignée	*Thymallus vexillifer*	6,000
River Bocq	Trout	6,000
River Ourthe and tributaries	Salmon	57,000
Do	Trout	63,000
Do	*Thymallus vexillifer*	6,000
River Gulpe	Trout	19,000
River Beek (Voeren)	do	3,000
River Solière	do	6,000
The Villaucour brook	do	12,000
Lake Gileppe	Lake trout	18,000
Do	*Salmo salvelinus*	12,000

Since 1885, when the Government undertook to stock the Belgium rivers, there have been planted, in all, in the tributaries of the Meuse, and in Lake Gileppe 737,000 young of salmonoids.

The plantings of young fish have been arranged in such a manner that in 1890, when the contract between the Government and the parties furnishing the young fish expires, all the tributaries of the Meuse which are to be stocked, will have received the kind and number of fish adapted to the nature of their water. But the quantity of young fish to be furnished within this period (about 1,000,000) is not sufficient to stock the rivers as thoroughly as it should be done. The question therefore arises, whether it is not possible to produce a certain quantity of young fish on the spot. For this purpose the keepers of waters

* "*Rapport sur les déversements d'alevins en 1886.*" Brussels, 1886. Translated from the French by HERMAN JACOBSON.

and forests in certain localities should be furnished with Jacobi boxes, which cost only 5 to 6 francs [96 cents to $1.16].

These arrangements are simple. They are long wooden boxes, with gratings at the ends, and at the bottom of which there is a bed of gravel on which the fecundated eggs rest. These boxes are placed in running water, which passes through them by the gratings fixed at each end. The eggs are therefore placed, so to speak, under natural conditions. Although certain observations might be made relative to this method, and although in more than one respect it leaves much to be desired, it nevertheless offers great advantages. The keepers should be charged to capture in the waters of their districts the necessary spawning fish, and the eggs obtained from them should be hatched in the waters about to be stocked. This method is not expensive and is exceedingly practical, and would serve admirably to maintain a constant state of production in our waters.

Next year experiments at acclimatization may be commenced with certain valuable kinds of fish, which are not yet found in Belgium, and which it may be desirable to introduce. Among these we mention the *Salmo fontinalis* and the *Salmo irideus*. As experience has shown, these two kinds of fish seem to adapt themselves perfectly to the nature of certain Belgian waters. The necessary fry will be produced, with very little expense, in the hatching houses in the Government botanical garden.

It appears that a man may safely transport a certain quantity of fry at a temperature of 1° C. [33.8° F.] in the apparatus, and of 10° C. [50° F.] in the atmosphere, for a distance of more than 20 kilometers [12½ miles]. Transportation in wagons for long distances has likewise been perfectly successful.

From the following observation it will be seen how important it is that the air should have free access to the apparatus. An experiment was made relative to the power of resistance of young fish to the difficulties connected with transportation. Two sets of apparatus, each containing 3,000 young trout, packed as described below, had been sent to Jemelle, whence on the following day they were to be sent to Brussels. On the evening before, the young fish were placed in the receptacles, the water in which was, up to the moment of starting, being constantly renewed. They arrived at Jemelle on March 12, at 9.49 a. m., and were placed in a cellar of the station. In spite of the instruction, the receptacle for the ice was left on one of them. As the temperature in the cellar was only 7° C. [44.6° F.] ice was not used. The temperature of the water was 8° C. [46.4° F.]. On the following morning, in the apparatus which had been left covered only 300 young fish were found alive, while in the one which had been left open there were only 20 dead. The heavy mortality in the first apparatus must be ascribed to the circumstance that there was not sufficient air, for the young trout

in both these apparatuses came from the same hatching, and the conditions of their existence were exactly the same.

When the cover was removed from the first apparatus, the surviving fish were found to be near the surface trying to get a breath of air. The water had a soapy appearance and the characteristic odor of fish in a state of decomposition. On the bodies of the dead fish, which had all undergone the fatty metamorphosis, there was found a very luxuriant cryptogamic vegetation of a whitish color. The surviving fish were placed in another apparatus containing fresh water, and arrived in Brussels in good condition on March 13, the water during the transportation having a temperature of 5° C. [41° F.]. As has been stated, the dead fish rapidly underwent the fatty metamorphosis, and a species of whitish mold developed on them, which gave to the water the appearance of a solution of brown soap, and a nauseating odor. The dead fish are very obnoxious in the apparatus, as they produce germs which soon taint all organisms. It is also important frequently to inspect the apparatus, especially if the young fish have to stay in it any length of time. In this case the water should be aerated, and renewed if possible, and all dead fish should be carefully removed at once.

It is also extremely dangerous to transport in one and the same apparatus young fish of different age. Young salmonoids are extremely voracious; when shut up in a narrow space, they will bite and endeavor to devour each other, thus frequently inflicting wounds which are fatal.

As has been shown in the transportation of young fish from Bavaria, it is also important to use only very pure water, filtered if possible; the impurities of the water get into the gills of the young fish and choke them. In the same transportation it was proved that the apparatus should not be too high, for too great a column of water exercises an abnormal pressure on the fish, which they are not able to bear. The management of very large transporting cans is exceedingly difficult.

We have noticed that the young of the *Thymallus vexillifer* are the most difficult to transport. When in a healthy condition they make efforts to swim towards the surface of the water; if they remain at the bottom it is a sure sign that they are sick. Salmon and trout, on the contrary, keep quietly together at the bottom of the apparatus; if they become restless and rise to the surface to get a breath of air, it is a sign that the oxygen in the water is diminished, or that the temperature is too high. As the case may be, the water should be aerated or renewed without delay, if it is possible to do this under good conditions. Care should be taken, however, not to renew the water as long as the young fish are in good health, for, as has been stated, any change of the element in which they live will invariably cause them suffering. However, if the water has become vitiated by the presence of dead bodies, one should not hesitate to renew it as soon as possible.

We also made an experiment in transporting grown fish of the *Cyprinidæ* family. We selected five *Cyprinus auratus*, which were fully de-

veloped, and among which there were three females with eggs. They were placed in an apparatus exactly like the one described below. The water had a temperature of 18° C. [64.4° F.], which is suitable for the transportation of cyprinoids, as we had ascertained in 1885, by experiments with young fish of the same kind. The transportation from Brussels to Jemelle proved a perfect success, and on their arrival at the latter place the fish were in good condition, and were placed in a small reservoir at the station.

We believe that the planting of young fish shortly before or after the absorption of the umbilical sac offers great advantages, as the younger the organism the better it will adapt itself to the element in which it is to live. When young fish are fed artificially, the instinct of preservation becomes weakened, the young fish become indolent, and are less able to escape their enemies and to seek their natural food, and consequently easily succumb in the struggle for existence.

However this may be, the attempt to stock our watercourses with young fish only a few weeks old has been perfectly successful. From information furnished by the keepers of waters and forests, and by fishermen, it appears that in those waters where young fish have been planted, numerous young salmonoids have been observed. Those which were planted in 1885 have already attained considerable dimensions, and next year they will have reached a marketable size.

It may be assumed that in three years the young fish will have reached the weight of one-half kilogram [$1\frac{1}{10}$ pounds]. This is a very small average weight, for the lake trout weigh much more at the age of three years. Assuming, on the other hand, that two-thirds of the 771,000 young fish planted up to date reach this age, we would have a total weight of 257,000 kilograms [566,582 pounds], which, at the price of $1\frac{1}{2}$ francs [about 29 cents] per kilogram, would represent a value of 385,500 francs [$74,401.50]. By stocking the watercourses with fish, therefore, the Government places at the disposal of the country a wholesome and cheap article of food.

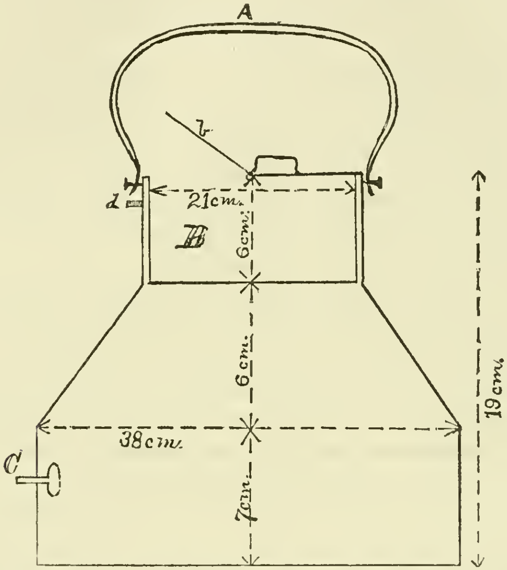
INSTRUCTIONS FOR PLANTING FRY.

Apparatus for transporting fry.—The transportation of young fish is a very delicate operation, and requires the greatest care. The cans in which young fish are transported are made of zinc, and covered with a special varnish. They have the following form and dimensions:

Each apparatus has a capacity of 11 liters [about $11\frac{1}{2}$ quarts], and will contain 3,000 young fish. When filled with ice, water, and young fish, the apparatus weighs about 14 kilograms [about 31 pounds]. The cans are transported from the stations where they are landed to the places where the fish are to be planted by means of a pack-saddle (brace), similar to the one used by water-carriers.

Maintaining the temperature.—The employees in charge must see to it that the water in the apparatus is kept at an even temperature. The

most suitable temperature is 5° C. [4° Réaumur or 41° F.], and it should not exceed 10° C. [50° F.]. The two extremes of temperature are marked in red on the thermometers furnished to the employees. If the water in the apparatus exceeds the maximum temperature, care should be taken to reduce it to a suitable degree by increasing the quantity of ice in the ice-box.



Height, 19 centimeters [7.48 inches]; breadth at neck, 21 centimeters [8.27 inches]; breadth of body of apparatus, 38 centimeters [14.96 inches].

A, handle for carrying the apparatus; B, reservoir for the ice; *b*, cover of this reservoir; C, spout for attaching rubber tube (by lowering this tube more or less, the water flows more or less rapidly from the apparatus); *d*, hook for holding up the tube.

It might happen that during transportation a solution of continuity might occur in the column of mercury in the thermometer. In this case the mercury should be reduced to its normal condition, by taking the instrument in one hand and pressing it, or by attaching it to a string and making it describe a rapid circular movement.

Aerating the water.—The respiration of the young fish vitiates the water in the vessels containing them. The renewal of oxygen is indispensable for keeping the fish in good health; and to neglect this would be to expose these young organisms to certain death. The air should be renewed at short intervals. Although this operation is necessary in all kinds of weather, it should be more frequent on very hot days; during the moments of rest the aerating pumps should be worked incessantly.

Nearly all authors are of opinion that during transportation the jolting of the vehicle is sufficient to aerate the water, but this is a mistake. As was shown at the transportation of young fish in 1884, it is very dangerous to count on the agitation of the water for obtaining aeration.

To do this will probably cause the rapid death of organisms of so delicate a nature as young fish.

There is an aerating apparatus consisting of a simple syringe furnished with a perforated mouth-piece. To renew the air, one breathes by means of the syringe into the water of the apparatus, and then places the mouth-piece at a short distance from the surface of the water, and makes the piston go down, not losing sight of the circumstance that little fish of a very delicate nature are concerned. The air should, therefore, not be blown into the water too violently.

Renewing the water.—When the distance to be traveled is very great, it will be well, whenever a favorable opportunity offers, to renew the water in the apparatus. To do this, one should have clear and drinkable water. In no case should muddy water, containing impurities, be employed. To renew the water in the apparatus, one inclines the tube C, so as to make the water flow off slowly; then he adds slowly, through the ice-box, new water, so as gradually to change the temperature of the element in which the young fish are kept. Too sudden a change of temperature would endanger the life of the young fish.

81.—NOTES ON HATCHING AND PLANTING YOUNG FISH IN ITALIAN WATERS.*

By Prof. PIETRO PAVESI.

In an address on fish-culture, delivered February 27, 1885, I stated that lavarets (*Coregonus wartmanni*) from the Lake of Constance had been placed in Italian waters at Lario at two different times (on February 27 and March 5), when the young fish had almost lost their umbilical sacs, and measured about 11 millimeters [nearly one-half inch] in length. Doubts were expressed as to the success of this experiment, but the eggs hatched. After the young fish appeared, however, the usual mold was observed. There are two suppositions to account for this mold: one, that it is caused by the quality of the water used in the hatching apparatus, in which case filters of the Waplitz model will have to be employed; the other, that some of the shells of the eggs broke in transportation and thus favored the development of mold.

I have now to report that my experiments resulted successfully. During October, November, and December, 1885, a number of little fish were caught near Bellano, which were about 4½ inches long, and in shape and color bore a strong resemblance to the fry I had planted. The fishermen cooked and ate some and found their flavor excellent, while some specimens that were sent to me here leave no doubt as to their being the same fish (*Coregoni*) planted by me. By planting more

* These notes are taken from an open letter to Prof. B. Benecke, of Königsberg, Germany, which is extracted from the report of the Italian Society of Natural Science, Milan, 1886. Translated from the Italian by HERMAN JACOBSON.

of these fish we shall eventually make Lake Como the Lake of Constance of Italy.

As regards the cultivation of Rhine salmon (*Salmo salar*), 100,000 eggs received from Mr. Carl Schuster, of Freiburg, Germany, were placed in hatching boxes of the Green system on January 14, and after they had been hatched the young fish were set at liberty on February 9 in the river Ticino. The day we placed the eggs in the boxes the water of the river was somewhat turbid, but soon became fresh and limpid again, having a temperature of 6° C. [about 43° F.], thus presenting the necessary conditions for the young fish, although the yelk sacs were not yet entirely absorbed. There was an alarming mortality, due to the sediment which formed at the bottom of the boxes, although this bottom was composed of a metallic net-work, and was separated from the bottom of the river by a considerable amount of flowing water, the Ticino having a rapid current. It must be said, however, that the boxes of the Green system, which hitherto had been used only for the cultivation of the shad (*Alosa præstabilis*) in America, and which I desire to see employed on a large scale in our lakes, have proved themselves well adapted even to eggs which, like those of the salmon, take a longer time to hatch. Another hatching experiment was made with eggs of the grayling (*Thymallus vulgaris*), which were placed in the upper Oglio. Eighty thousand eggs were received from Mr. Schuster (50,000 of them being in very poor condition), from which number we succeeded in hatching about 15,000 beautiful and healthy young fish, which, on May 27, 1885, were placed in the river not far from Darfo.

It was not thought advisable to hatch the 100,000 embryonated eggs of the *Salmo fario* and of the *Salmo salvelinus*, but those eggs which were very near being hatched were placed directly in lakes and rivers. Many fish-culturists, like Haack, Schuster, and Benecke, are opposed to this method; but when there are difficulties in the way of hatching, as was the case here, it seemed the best way of restocking the waters. The chief objection seems to be that natural causes will destroy the eggs, more especially that they will become a prey to their voracious enemies, such as the *Lota vulgaris*, the *Leuciscus cephalus*, and the *Chondrostoma soëtta*. But these fish do not approach the shores of the lakes in winter, when the eggs of trout and similar fish are placed in the water. In placing embryonated eggs in the water, everything will depend on the selection of a suitable place, and on having careful regard to the physical and biological conditions of the water. Care should also be taken not to crowd the eggs into too limited a space, but to scatter them somewhat. Even if only ten out of every thousand reach the state of maturity, there will be that many reproducers of fish in the public waters.

Hardly had the 100,000 trout eggs been received from the establishment of Torbole, on January 8, 1885, when one-half was planted at the mouths of the rivers Plesna and Rivalaccio, near Pella; while the other

half was planted near the falls of the Qualba, a very suitable locality, owing to the sandy bottom and the nearness of a rich aquatic vegetation. All the eggs planted in the two locations referred to were exceptionally fine and healthy. Quite a number of young fish have been observed here, which goes to show, first, that the eggs from the Torbole establishment had been hatched, although some people maintained that this would not be the case, as they had not been fecundated according to the Russian system; and in the second place, that large fish had not come near the shores and devoured them.

Another 100,000 embryonated trout eggs, received from Torbole in an excellent state of preservation, and destined for the Venetian waters, were sent to Count Ninni, who selected the locations where they were to be planted, namely, one-half in Lake Lapisino and the other half in the waters near Trevigiano. These were planted on January 6 and 8 at different spots, where there was a suitable bottom and pure water Some specimens of the eggs were taken to Venice and there hatched in a small apparatus on January 16, with such success that 130 healthy young fish were placed in open waters, thus proving the excellent quality of the eggs.

Fifty thousand eggs of the *Salmo salvelinus* were received from Freiburg, Germany, and on January 18 were planted in Lake Idro, at a depth of about 10 feet, on a sandy and rocky bottom. Some specimens of these eggs were sent to Pavia, and were very successfully hatched between January 30 and February 1.

Finally, 800,000 young eels, taken near the mouth of the river Arno, were planted in Lake Trasimeno, where they could find ample food in the innumerable *Leuciscus aula*. In former years this lake was very rich in eels, and it is to be hoped that it will regain its ancient fame in this respect, as some of the young eels which were planted have already been caught in an advanced state of development.

PAVIA, ITALY, *December* 15, 1885.

82.—THE SEA FISHERIES OF NORWAY.*

By Dr. FRIEDRICH HEINCKE.

In no country do the sea fisheries play such an important part in public affairs as in Norway, nowhere is such a general interest taken in them, and in no country are better and more exhaustive fishery statistics taken. For centuries the Government has taken account of the results of the fisheries, and for more than twenty years regular and extensive statistics have been obtained. A uniform plan, however, has been followed only since 1876; and the annual reports published since

*"*Die Seefischereien Norwegens.*" From *Mittheilungen der Section für Küsten- und Hochsee-Fischerei*, Berlin, July and August, 1886. Translated from the German by HERMAN JACOBSON.

that year by the statistical bureau at Christiania give an excellent idea of the condition of the Norwegian sea fisheries.

Norwegian statisticians refer to the extraordinary difficulties in the way of obtaining reliable statistics, and to the consequent necessity of confining them within certain limits. The daily small fisheries, which play an important part in the households of the fishing population, have been entirely left out from the reports, because it was absolutely impossible to obtain any reliable data; the statistics consequently relate only to the fisheries which have been regularly carried on on a large scale. Even in these statistics no account could frequently be taken of the fish which were immediately consumed by the fishermen, so that in many cases the reports covered only the fish which were brought into the market. It will therefore be seen that in most cases the figures given in the statistics are below the actual figures. Least reliable are the statistics relative to the herring fisheries, over which it is exceedingly difficult to exercise any control; while the statistics of the Lofoden cod fisheries and the so-called "lodde" fisheries in Finmark are the most reliable, and in fact often absolutely correct, because these fisheries have for years been under a police supervision organized on a model system.

There are separate statistics for every fishery, covering many different points, especially the number of fishermen, boats, and apparatus; the total yield of the fisheries and the separate yields according to provinces, counties, districts, and sub-districts; the value of the fish; the quantities of fish cured in various ways; the prices of fish; the shares and wages of the fishermen; the quantity of fish exported from Norway, giving the entire quantity and the quantities exported from each port, &c.

According to the census of December 31, 1875, there were engaged in the fisheries 33,255 male persons upwards of fifteen years of age, that is, 6 per cent of the adult male population. To these should be added 23,381 male persons upwards of fifteen years of age who occasionally engaged in fishing; therefore a total of 56,636, or 10 per cent of the adult male population. In no other civilized country is the percentage of fishermen so large as this.

The total value of the Norwegian fisheries (exclusive of oysters) was, for the period from 1866 to 1874, on an average per annum 22,470,000 crowns* [$6,021,960], the minimum (1869) was 18,644,000 crowns [$4,996,592], and the maximum (1877) 29,434,000 crowns [$7,888,312]. These calculations, like all the following, have been made on the basis of the average prices paid at the fishing stations; they cannot, therefore, lay claim to absolute correctness, but give a fair approximation of the actual value.

As regards the different kinds of fisheries carried on in Norway, this country shows a remarkable difference from all other nations inhabit-

* The reductions are made on the basis of one crown equaling $26\frac{8}{10}$ cents.

ing the shores of the North Sea and carrying on sea fisheries. This difference is caused by the nature of the bottom of the sea off the coast of Norway. From the Skager Rack to the Polar Sea the bottom in immediate proximity to the coast sinks to a considerable depth, only a few of the numerous fiords having a depth of less than 100 fathoms. The North Sea proper, on the other hand, and the sea surrounding the British Isles, has a depth of more than 100 fathoms in only a few places, but is full of flat banks, approaching the surface of the sea within 10 fathoms or less. This explains the wealth of the North Sea in flat-fish and the great importance of the English trawl-net fisheries in the North Sea. The case is very different in Norway. Here the deep bottom of the sea has very few flat-fish, or at least trawl-nets cannot be employed on account of the great depth. Plaice, halibut, and even haddock are therefore not caught very frequently, and their place is taken by the fish inhabiting the open ocean, such as the cod, herring, and mackerel, which approach the coasts at certain seasons of the year for the purpose of spawning.

The main places of sojourn of all these fish are far out in the open sea, or farther north in the Polar Sea, that is, in regions which so far have been almost entirely inaccessible. Thus the enormous shoals of fish which at regular seasons approach the coasts of Norway appear to the Norwegians more than to other nations as the gift of providence, which man may accept, but which he can in no wise either increase or decrease. In fact, the history of the Norwegian fisheries and the statistics of the last twenty years show that the fluctuations in the yield have nothing whatever to do with excessive fishing or other hurtful measures taken by the fishermen, as is to some extent the case on the British coasts, but that they must be explained from entirely different (and so far unknown) causes, to be found in the nature of these northern seas.

As regards the kinds and yields of the sea fisheries, the entire coast of Norway may be divided into four districts: The first is the coast of the Skager Rack from the boundary of Sweden to Cape Lindesnaes. It produces about 3½ per cent of the entire yield of the fisheries. The second district is that of the North Sea from Cape Lindesnaes to Cape Stat, yielding about 9 per cent. The most important fisheries of this district are the spring-herring, lobster, and salmon fisheries. The third district is the Norwegian North Sea coast from Cape Stat as far as the island of Soröe, in Finmark. Here the most productive of all the Norwegian fisheries are carried on (about 71 per cent). This is the region of the fat-herring, great-herring, and cod fisheries. The fourth district embraces the coast of the Polar Sea, from the island of Soröe, yielding about 17 per cent. The principal fish caught in this district is the spring cod. The above will show that it is not the North Sea proper, but the open ocean, which is the main source of the Norwegian wealth of fish.

The most important of all the Norwegian fisheries are the cod fisheries, their production being about 60 per cent of the entire yield. These fisheries are carried on within a distance of 10 miles * from the coast, almost exclusively with open boats, which carry nets, long-lines, and hand-lines. Every boat with nets has a crew of three or four men; every boat with long-lines, generally three; and every boat with hand-lines, four. The net fisheries are the most expensive, but also the most productive, while the hand-line fisheries are the cheapest, but the least productive. Prior to 1881 nets were mostly used, but of late years the line fisheries have become more important, the hand-line fisheries yielding on an average 8 to 10 per cent of the entire production.

During the period from 1879 to 1884 there were on an average engaged in the cod fisheries 77,289 fishermen, with 18,135 boats, the average annual yield being 53,516,000 codfish, valued at 12,544,000 crowns [$3,361,792]. In 1880 the number of cod caught was 68,000,000; in 1883, only 33,000,000; and in 1884, 50,000,000. It will thus be seen that there are great and sudden fluctuations in the yield, but as far as our statistics go they have quickly reached the usual average, while the causes of these fluctuations are entirely unknown.

The entire cod fisheries may be subdivided into the winter cod fisheries and the spring cod ("lodde") fisheries. In the winter cod fisheries fish are caught which, when approaching the coast, contain a great deal of roe and milt. These fisheries last from January till April, when the fish, having spawned, again leave the coast. The main winter cod fisheries are carried on near the Lofoden Islands. The spring cod make their appearance on the coasts of the Polar Sea from February till May, and are not mature fish (not ready to spawn). They only come near the coast in pursuit of the "lodde," a kind of smelt, which at this season frequents the bays of the Polar Sea in enormous quantities, and is caught for the purpose of serving as bait. Consequently but few nets are employed in the cod fisheries, but principally long-lines and hand-lines.

The winter cod fisheries near the Lofoden Islands and Vesteraalen, carried on principally on the side of these islands towards the mainland, have from time immemorial been the most important fisheries of Norway, and are unique. From January innumerable fishing boats come to these islands from all parts of Norway, accompanied by trading vessels, which carry the necessary supply of salt for salting the fish, which buy a great many fish, and supply many of the wants of the fishermen. The entire fisheries, from January 16 till April 14, are under the careful and strict supervision of a naval officer, and they are thoroughly regulated by numerous laws and regulations. The supervising officer is also commissioned to take the statistics of these fisheries. These statistics are exceedingly comprehensive and exact. During the last ten years there were engaged on an average, per annum in this district, about 25,000 fishermen, with about 6,000 boats, and the annual aver-

* This is probably the Norwegian mile, which equals about 4.7 English miles.

age yield was 24,000,000 codfish, each weighing on an average 4 kilograms [8.8 pounds]. The number of trading vessels was on an average from 500 to 600, of which more than 100 were exclusively engaged in supplying the fishermen with articles of food, clothing, and other necessities of life. Liquor can be sold to the fishermen only by specially licensed persons, one to every 400 or 500 fishermen. Owing to the weather, fishing cannot be carried on every day, but generally on from three to five days a week. The temperature of the atmosphere is, of course, low; during the years 1879 to 1884 it varied during the season only from -2.2° to $+2.4^\circ$ C. [about 28° to 36½° Fahr.]. There are on the coast regularly about 100 persons engaged in serving and amusing the fishermen, such as photographers, restaurant keepers, musicians, and owners of panoramas and other shows. The majority of the fish caught near the Lofoden Islands (about two-thirds to three-fourths) is worked into "klip-fish," that is, the head is cut off, the backbone and entrails are taken out, and the fish are then salted and dried. The remaining portion of the fish are dried without being salted, and are called "stock-fish." Of these latter there are three kinds, namely, the common "stock-fish," called "round-fish," of which only the head and the entrails have been removed; when the fish has been split lengthwise along the back, the backbone has been taken out, and the two halves have been pressed asunder, it is called "rotscher" or "flack-fish;" and the third and least valuable kind is the "sei" or dried *Gadus carbonarius*. "Klip-fish," of course, fetches a higher price than "stock-fish."

Next to the fish the most important product of the Lofoden fisheries is cod-liver oil. During the years 1875 to 1884 there were, on an average, produced per annum 26,500 barrels of common cod-liver oil and 2,440 barrels of fine (so-called medicinal) cod-liver oil. The roe of the cod is salted and sold as bait to the French sardine fishers. Formerly the heads were generally thrown into the sea or dried and used for feeding the cattle. Of late years, however, buyers regularly visit the fishing stations and buy the heads for guano factories. As early as 1878, 53 per cent of all the heads were used in guano factories. According to a calculation for the period 1876 to 1878, the total value of the Norwegian cod fisheries was distributed as follows: The fish themselves, 73.3 per cent; liver and cod-liver oil, 18.3 per cent; roe, 7.7 per cent; and heads, 0.7 per cent.

The total annual value of the Lofoden fisheries from 1876 to 1884 has averaged 6,200,000 crowns [$1,661,600].

The spring cod fisheries (the "lodde" fisheries) in the Polar Sea are likewise very important. From 1869 to 1884 there were on an average engaged per annum 3,714 boats with 12,825 fishermen. Many of these come there after the Lofoden fisheries have come to end. During the last six years the average annual yield was 13,000,000, valued at about 2,500,000 crowns [$670,000]. Of late years the yield has fluctuated

very much, as in 1880 it was upwards of 23,000,000 fish, while in 1883 it was only 3,500,000 (the smallest yield during the last 25 years); in 1884, however, it had again reached 16,000,000. The fish were in equal parts worked into "klip-fish" and "stock-fish," the latter being almost exclusively "round-fish."

Besides these cod fisheries within the 10-mile limit, cod fisheries are also carried on farther out, off the coast of Romsdal, in covered boats. Swedes, occasionally Frenchmen, and fishermen from the Färöe Islands also engage in these fisheries. On an average 100 boats are every year engaged in these fisheries, and the yield has averaged 1,000,000 fish. Cod fisheries are also carried on during the summer near Spitzbergen by boats from Transöe and Finmark. The yield varies very much, averaging from 250,000 to 500,000 per year.

The Norwegian herring fisheries, comprising about 25 per cent of the total annual yield of the fisheries, and during the period from 1866 to 1884 yielding annually fish to the average value of 6,400,000 crowns [$1,715,200], are of four kinds, namely, the spring-herring fisheries, the fat or summer herring fisheries, the great or north herring fisheries, and the small herring or sprat fisheries. These fisheries are carried on with open boats, partly with floating nets and partly with stationary nets. The boats with floating nets are generally about 30 feet long and 10 feet broad, and have as a rule gaffs, jibs, and foresails, a crew of 4 or 5 men, and from 20 to 60 nets, each 10 to 15 fathoms long and 100 to 120 meshes deep, with cork or glass floats at the top and with stone weights at the bottom. According to the depth at which the shoals of herring are found, the nets can be set nearer to or farther from the surface. The fisheries with stationary nets are carried on by associations, each consisting of 13 or 14 men, and owning several boats and nets. When the herring which have entered a fiord want to get out again, the entrance of the fiord is closed with one or several large stationary nets, and the fish are then caught with seines. It has happened that in small fiords which had been closed in this manner, such enormous masses of herring had been shut up that they could be dipped out with pails or caught with the hand.

The spring herring is a large full herring which comes from the North Sea in January and February for the purpose of spawning, and in dense shoals, the approach of which may be recognized by a peculiar movement of the surface, and by the whales following in their wake and the sea-gulls hovering over them. These herring enter the fiords, especially north and south of Stavanger. In former years this fish formed the principal object of the Norwegian herring fisheries. But from 1786 till 1807 they failed to approach the coasts of Norway in any considerable quantity; from 1807 on, however, these fisheries again became productive. During the last twenty years the largest quantity (947,000 hectoliters* = 2,680,010 bushels) was caught in 1869; from that year on

* The hectoliter equals about 2.83 United States bushels.

the yield very rapidly decreased to 1,200 hectoliters [3,396 bushels] in 1874, kept on fluctuating, with a slight tendency toward an increase, and finally rose from 32,000 hectoliters [90,560 bushels] in 1883 to 261,000 hectoliters [738,630 bushels], valued at 1,500,000 crowns [$402,000], in 1884.

At present the fat or summer herring fisheries are much more important than the spring-herring fisheries. The summer herring fisheries furnish 20 per cent of the yield of the entire Norwegian fisheries. The summer herring is not a spawning fish, but probably a herring which has fattened again after spawning. It appears in the sea from Cape Stat to the island of Soröe, principally in the district of Northland, south of the Lofodens, and near these islands. In this region it fills the fiords and bays during the summer and autumn months. By far the greater portion are caught in stationary nets. From 1879 to 1884 there were annually engaged in these fisheries an average of 29,187 fishermen, with 5,377 drift-net boats, and 1,077 stationary net associations. The annual average yield was 568,000 hectoliters [1,607,440 bushels], valued at 4,233,000 crowns [$1,134,444]. The fluctuations of the yields are not near so great as in the spring herring fisheries.

Still more mysterious than the spring herring is the so-called great or north herring. Prior to 1863 it was entirely unknown; but in that year it appeared, a very large mature herring, in considerable numbers on the coasts of Northland and South Finmark, from November till the beginning of January, and disappeared in 1874 without leaving a trace. These fisheries were mostly carried on with stationary nets, and their annual yield from 1863 to 1874 varied between 69,000 and 1,056,000 hectoliters [195,270 to 2,988,480 bushels].

The small herring or sprat fisheries furnish the well-known Christiania anchovies and other small herring, and are principally carried on in the North Sea, from Cape Lindesnaes to Cape Stat; they furnished from 1879 to 1884 an annual average of 156,000 hectoliters [441,480 bushels], valued at 338,000 crowns [$90,584].

The Norwegian mackerel fisheries are confined to the coast from the boundary of Sweden to Cape Stat, therefore to the Skager Rack and the North Sea. Since 1858 fresh mackerel on ice have been exported, especially to England, and since that time these valuable fisheries have increased considerably. The mackerel come to the coast in May and stay till autumn. The fisheries are carried on partly with floating lines, partly with drift-nets and stationary nets, but principally (and increasingly so) with large covered boats and drift-nets. Each net is 20 to 30 fathoms broad and 80 to 120 meshes deep (breadth of meshes from 38 to 40 millimeters [about 1½ inches]), and 40 nets form a set. They are cast in the evening and taken up in the morning. During the period from 1879 to 1884 there were on an average engaged in these fisheries per annum 3,767 fishermen, with 974 boats with drift-nets. The average annual yield was 5,586,000 mackerel, valued at 720,000 crowns [$192,960].

Where the mackerel fisheries cease, as they do near Cape Stat, other very important fisheries commence in summer and autumn, and extend as far as the Polar Sea, giving the largest yields on the coast of Finmark. These are the so-called summer fisheries for ling (*Lota molva*), *Brosmius brosme*, *Gadus carbonarius*, halibut, flounder, and other deep-water fish, which are carried on partly in open and partly in covered boats with lines and hand-lines, and extend beyond the 10-mile limit. The importance of these fisheries will appear from the fact that their yield comprises about 10 per cent of the entire yield of the Norwegian fisheries, and from 1869 to 1884 was valued at an average annual sum of 2,458,000 crowns [$658,744]. Of late years these fisheries have increased considerably. The fish are prepared in various ways, salted or dried.

The salmon and salmon-trout fisheries carried on near the coast and at the mouths of rivers have also increased very much since fresh salmon on ice have been exported. Different kinds of apparatus are employed in the fisheries; stationary and drift nets, traps, lines, and fish-hooks or spears. From 1869 to 1884 the average annual yield was 366,000 kilograms* [806,884 pounds], valued at 387,000 crowns [$103,716]. The more important fishing stations are in the Skager Rack and in the North Sea.

Of special interest are the Norwegian fisheries in the Polar Sea, which, exclusive of the spring cod and ling fisheries described above, are principally carried on beyond the 10-mile limit, by open and covered boats from Transöe, Hammerfest, and Vardöe. The most important fish caught are *Delphinapterus leucas*, *Scymnus borealis*, codfish; beside seals, walruses, and whales. The most important of these fisheries are the whale fisheries, which are principally carried on in the Varanger Fiord with steamers and harpoons fired from guns. After the fat has been removed from the whale the rest of the body is worked into guano. These fisheries have increased considerably during the last few years. In 1878 only 135 whales were caught, valued at 266,000 crowns [$71,288]; while in 1883, 561 were caught, valued at 1,011,000 crowns [$270,948]. Walrus fisheries and seal fisheries are during the summer carried on near Spitzbergen, and from 1878 to 1884 yielded, on an average, annually 433 walruses and 8,120 seals, besides whitefish, polar bears, reindeer, and eider-down. The *Scymnus borealis* is caught with harpoons, partly with open boats near the coast, and partly with covered boats far out at sea. Its liver is used for preparing oil. From 1881 to 1884 there were annually engaged in these fisheries 22 open boats, each with 4 men, and 26 covered boats, each with 5 men. These fisheries yielded on an average 4,713 hectoliters† [124,894 gallons] of oil, valued at 94,000 crowns [$25,192].

OLDENBURG, GERMANY, *June*, 1886.

---

*A kilogram equals 2.2046 pounds.

†A hectoliter equals about 26½ United States standard or wine gallons.

Vol. VI, No. 18. Washington, D. C. Nov. 12, 1886.

83.—NEW ENGLAND FISHERIES IN SEPTEMBER, 1886.

By W. A. WILCOX.

Mackerel have continued scarce both off the United States and provincial shores. The first of the month found a large portion of the mackerel vessels from the United States in the Gulf of Saint Lawrence. Much of the time high winds and rough weather detained them in harbors. Two vessels belonging at Portland, Me., in making Malpeque, Prince Edward Island, in stormy weather, collided and became a total loss; the crews were saved. The fleet received much damage and lost many seine boats. A number of vessels that had secured good fares arrived home and immediately returned, meeting with others coming away with few if any fish.

Among the arrivals during the month are the following from voyages of from one to two months or more spent in the Gulf of Saint Lawrence:

Name.	Home port.	Barrels of mackerel.
Schooner Fannie L. Nye	Boston	80
Schooner Roulette	Philadelphia, Pa	None.
Schooner Lucy W. Dyer	Portland, Me	None.
Schooner William H. Jordan	Gloucester, Mass	40
Schooner Canopus (eight weeks)	do	30
Schooner Henry Friend	Swan's Island, Me	40
Schooner E. R. Nickerson	Boothbay, Me	50
Schooner Nathan Cleaves	Wellfleet, Mass	77
Schooner Carrie G. Crosby	do	10
Schooner Asa H. Pervere	do	75
Schooner Edward Rich	do	10
Schooner Pleiades	do	40
Schooner Millie Washburn	Provincetown, Mass	55

This list could be largely extended, but will suffice as showing the scarcity of mackerel during the month. The total amount landed in sea-packed barrels at New England ports from all the fishing grounds was only 21,736 barrels, against 58,196 barrels in September, 1885. Owing to the scarcity and poor prospects of a catch, the market has held firm, and prices have slowly advanced from $12 a barrel on the first of the month to $14 at the close, for fish sea-packed. Inspected fish were selling for $18 to $22 for No. 1's, $12 to $13 for No. 2's, and $10.50 for No. 3's. Fish caught off the New England shore brought an advance over prices named, which are for mackerel caught in the Gulf of Saint Lawrence.

Shore herring appeared off Wood Island, Maine, on September 15, about the usual time that they are found there. The fishermen have

had a fair catch, and remained there during the month. The herring fleet numbered one hundred and fifty sail, mostly small vessels, averaging three men and six nets each, vessels having from three to twelve nets according to size and number of crew. The average catch has been 100 barrels to a vessel, or total to September 30, 15,000 barrels. The fish have remained off Wood Island much longer than usual. At the close of the month fishermen were watching for them off Cape Ann, but with the exception of a few scattering fish none had been caught. On September 22 and 23, 1885, 1,800 barrels of shore herring were taken in Gloucester Harbor. A few days more will probably find the fish and fleet around the shores of Cape Ann. The herring are of good size and quality and full of roe.

Codfish, halibut, and mackerel, the leading salt-water food-fish, all show a large decrease in receipts as compared with September, 1885. Receipts of codfish at Gloucester from George's and Brown's Banks show a falling off of 1,095,000 pounds; this is accounted for from vessels having fished more on Western Bank, where fish and squid were plentiful, vessels securing good fares landing 1,511,000 pounds, against none from there during September, 1885. The fish from the latter bank were of larger size and better quality than for a number of years.

The total receipts of cod at Gloucester during the month were 2,800,000 pounds less than for the corresponding month last year. The extreme low prices have prevented any cargoes coming in foreign bottoms, against seven cargoes of over 2,000,000 pounds in September, 1885. Off the New England coast codfish have been more abundant than of late years. The shore catch are considered better fish and bring higher prices than those from any other fishing grounds except George's Bank. Some extra large fish were found quite near the coast; one weighing 65 pounds was taken only 3 miles from Eastern Point light, Gloucester Harbor, by Capt. Jewett Wilcox, of Chicago, a summer visitor.

The Grand Banks codfish fleet have nearly all returned to home ports, having secured full fares and met with no serious losses.

Bait has been plentiful on the fishing banks. On Western Bank squid have been very abundant, vessels taking all they wanted, often leaving port without any bait, depending entirely on catching plenty on the fishing grounds, in which they were not disappointed. Weirs and traps at nearly all points located between New Castle, N. H., and Maine ports as far as Southwest Harbor, have at all times had an abundance of herring bait. At Cape Cod the weirs have had a light catch of any kind of fish during most of the month. The traps in Gloucester Harbor have taken but few herring or mackerel.

Halibut have continued scarce. The receipts show a large decrease from those of the corresponding month last year. Vessels that went to Iceland for halibut are returning with only partial fares, caused more from having had unfavorable weather for fishing than from a scarcity of fish.

Hake, haddock, and cusk have been found fairly abundant, the catch off the eastern coast having been an average one.

Trade has improved during the month, large quantities of fish being daily distributed and going into immediate consumption. With the exception of mackerel, prices have ruled very low on all the leading varieties.

Mackerel landed by the New England fleet, in sea-packed barrels, at all ports.

Time.	1883.	1884.	1885.	1886.
Up to September	91,299	221,440	223,152	37,303
September 1 to 8	10,904	42,319	29,454	5,502
September 9 to 15	13,193	27,331	6,435	5,507
September 16 to 22	13,566	28,608	9,235	8,267
September 23 to 30	18,074	34,327	13,072	2,460
Total to October	147,036	354,025	281,348	59,039

Number and location of fishing vessels from New England ports on September 30, 1886.

Location.	Object.	No. of sail.
Grand Banks	Codfish	25
Grand Banks	Halibut	20
Banquereau	do	10
East of Sable Island	do	10
Between George's and Brown's Banks	do	15
George's and Brown's Banks	Codfish	195
Sable Island Bank	do	40
Off the New England coast	Ground fish	250
On the way home from trips to Iceland	Halibut	2
Gulf of Saint Lawrence	Mackerel	90
Off the New England coast	do	125
Total		782

Receipts of fish at Gloucester, Mass., in September, 1886.

From—	Fares.	Salt codfish.	Fresh halibut.	Salt hake.	Salt haddock.	Salt pollock.	Salt cusk.	Mackerel.	Herring.	Fresh swordfish.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Bbls.*	*Bbls.*	*Lbs.*
George's Bank	58	1,023,000	148,560				12,000			
Brown's Bank	34	1,159,000	3,150							
Grand Banks	8	162,000	241,000							
Iceland	3		390,000							
Banquereau	16	100,000	361,800							
Jeffrey's Bank	2					20,000				
Bay of Fundy	4	74,000								
Nova Scotia, Cape shore	1	45,000								
Western Bank	30	1,511,000	2,900							
La Have Bank	4		75,000							
Cashe's Bank	1	15,009	15,000	4,000						
New England shore	19	33,000		60,000	56,000					6,064
Do	3								518	
Do	9							482		
Greenland and Flemish Cap	1	30,000	40,000							
Gulf of Saint Lawrence	36							8,983		
Total, September, 1886	229	4,152,000	1,277,410	64,000	56,000	20,000	12,000	9,465	518	6,064
Total, September, 1885	353	6,952,000	2,375,000	41,000		47,000		26,580	3,135	12,600

September, 1886, additional from small shore boats: 38,000 pounds of hake; 12,000 pounds of cod.

GLOUCESTER, MASS., *October* 14, 1886.

84.—FIVE RECEIPTS FOR COOKING CARP.

The following receipts were transmitted by Herr von Behr, in a letter to Professor Baird, from Schmoldow, Germany, dated December 21, 1885. He spoke of these recipes as being methods for cooking the carp in German fashion, and hoped that they would be extensively tried in America.

(1) Blue carp.—Do not scale the carp, but cook it until done, in strong salt water, with vinegar, spices, pepper, and parsley roots, and serve with the following sauce: To 1 pint of white sauce, cooked until it thickens, add several table-spoonfuls of herb vinegar, one-fourth of a pint of sour cream, and some horseradish (one-fourth of a common-sized root) grated fine.

(2) Another style of blue carp.—Do not scale the carp, and cook until done in strong salt water, with vinegar, spices, pepper, and onions. Serve with melted butter and a hard-boiled egg chopped fine or sliced, or with fresh butter beaten until it resembles whipped cream.

(3) Bohemian carp.—In killing the carp save the blood and stir it with some vinegar; cut the carp in pieces and cook in the following sauce: Take one bottle of claret (Bordeaux) to 4½ pounds of carp, about 4 ounces of butter, 4 ounces of gingerbread, spices and pepper to flavor. Cook until it thickens somewhat, and, when boiling hard, put in the pieces of fish, well salted, and cook them until done. Or, instead of taking only claret, take one-half beer and one-half claret, and cook with it soaked raisins and prunes, which are left in the sauce and served with it.

(4) Fried carp.—Scale and clean the fish, and make some slight incisions on both sides; if too large, cut in pieces. Just before putting the fish in the boiling lard, wipe it dry, sprinkle slightly with flour, dip in beaten eggs, and roll in fine bread-crumbs. Put one piece after the other into the boiling lard, so that the pieces do not touch each other. As soon as a piece ceases to hiss it will quickly assume an even brown color and rise to the surface. When sufficiently brown take it out with a large spoon and lay on a hot sieve to let the superfluous fat run off; sprinkle with fine salt, and lay in a hot dish without cover, so as to prevent the crisp crust from becoming soft. Serve very hot.

(5) Baked carp.—Scale and clean the carp, salt and pepper strongly, wrap in paper thickly buttered on the inside, again wrap in several sheets of paper which have been moistened, so as to prevent the ashes from penetrating. Bake half an hour in very hot wood ashes, covering the fish thickly with ashes.

Berlin, Germany, *December* 21, 1885.

85.—ANOTHER RECEIPT FOR COOKING CARP.

By JULIUS GROSS.

In my family, carp have been eaten at all seasons of the year, but they are preferred during spring and fall. The spawning fish, either immediately before, during, or just after spawning time, are not fit to eat. We have cooked carp with and without the scales; but like them better with the scales, as a kind of jelly is then formed on the fish.

They have been cooked in several different ways, but the following is the one that we prefer:

BAKED CARP.—Bake in an oven with butter sauce; use spice, such as lemon and laurel leaf, according to taste. After the carp are finished and on the dish, a sauce of cream and eggs should be poured over them.

COLUMBIA, ILL., *October* 18, 1886.

86.—RECORD OF HYDROGRAPHIC SOUNDINGS AND DREDGING STATIONS OCCUPIED BY THE STEAMER ALBATROSS IN 1886.

By Lieut.-Commander Z. L. TANNER, U. S. N., Commanding.

In the following tables the abbreviations for the characters of the bottom and the instrument used are from the following code:

Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.
C	Clay.	fne	fine.	stf	stiff.
Co	Coral.	lge	large.	bk	black.
St	Stones.	rky	rocky.	bu	blue.
G	Gravel.	rtn	rotten.	dk	dark.
S	Sand.	stk	sticky.	gy	gray.
For	Foraminifera.	br	brown.	rd	red.
Pter	Pteropods.	choc	chocolate color.	wh	white.
M	Mud.	gn	green.		
P	Pebbles.	lt	light.	L. B. T.	Large beam-trawl.
Oz	Ooze.	slat	slate color.	S. B. T.	Small beam-trawl.
R	Rock.	yl	yellow.	Bl. Dr.	Blake dredge (deep-sea dredge).
Sh	Shells.	crs	coarse.		
Glob	Globigerina.	hrd	hard.	Sh. Dr.	Ship's dredge (mud-bag).
Sp	Specks.	sml	small.		
brk	broken.	sft	soft.	Tgls	Tangles.

For the record of hydrographic soundings preceding those herewith reported, reference should be made as follows: Nos. 46–557, pages 111–112, Fish Commission Report for 1884; Nos. 591–868, pages 74–77, Fish Commission Report for 1885.

Record of hydrographic soundings of the U. S. Fish Commission steamer Albatross, from January 1 to October 26, 1886.

Serial number.	Date.	Hour.	Position. Lat. N.	Position. Long. W.	Depth.	Character of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Current.
	1886.		° ′ ″	° ′ ″	*Fathoms.*		°	°	°	
869	Feb. 23	10.36 a. m.	28 41 00	78 03 00	557	gy. S. bk. Sp	69	70	39.7	Nominal.
870	Feb. 23	12 m	28 40 00	77 52 00	570	gy. S. bk. Sp	71	68	39.7	Do.
871	Feb. 23	1.30 p. m.	28 40 00	77 37 00	572	gy. S. bk. Sp	73	73	39.7	Do.
872	Feb. 23	2.58 p. m.	28 41 30	77 28 00	581	gy. S. bk. Sp	86	74	39.7	Do.
873	Feb. 23	4.44 p. m.	28 42 00	77 09 00	600	wh. S	86	74	39.2	Do.
874	Feb. 23	6.45 p. m.	28 42 30	76 53 30	623	gy. S. bk. Sp	71	70	39.2	Do.
875	Feb. 23	8.20 p. m.	28 42 45	76 39 00	762	Oz	67	70	39.7	Do.
876	Feb. 23	9.58 p. m.	28 43 00	76 26 55	2,845	Oz	70	70	36.8	Northwest by north, 1 knot.
877	Feb. 24	12.51 a. m.	28 34 42	76 10 25	3,196	Oz	68	69	36.8	Northwest, 1½ knots.
878	Feb. 24	4.20 a. m.	28 24 06	76 15 55	1,407	No specimen	69	71	37.8	Nominal.
879	Feb. 24	6.02 a. m.	28 12 30	76 15 00	691	gy. S	69	71	39.2	Do.
880	Feb. 24	7.41 a. m.	28 01 00	76 13 00	622	yl. Oz. gy. S	69	71	39.2	Do.
881	Feb. 24	9.10 a. m.	27 49 00	76 12 00	633	gy. and br. S	70	71	39.5	Do.
882	Feb. 24	10.41 a. m.	27 38 00	76 23 24	677	br. S	72	71	39	No current.
883	Feb. 24	12.08 p. m.	27 27 00	76 12 00	705	gy. and br. S	74	71	39.1	Do.
884	Feb. 24	2.08 p. m.	27 42 00	76 02 00	762	For	70	72	39.2	Do.
885	Feb. 24	5.25 p. m.	27 51 00	75 53 30	2,599	No specimen	71	73	....	Do.
886	Feb. 25	6.45 a. m.	27 30 00	75 35 00	2,761	No specimen	70	71	....	North by west, 2 knots.
887	Feb. 26	4.14 a. m.	25 29 00	74 50 00	2,589	For. Oz	73	72	....	North by west, ½ knot.
888	Feb. 26	10.40 a. m.	24 50 00	74 36 45	2,709	br. Oz	74	73	36.7	
889	Feb. 26	2.59 p. m.	24 25 00	74 36 00	2,639	br. Oz	76	75	37.6	
890	Feb. 26	6.52 p. m.	24 08 00	74 35 00	1,135	hrd	74	73	38.6	
891	Feb. 27	12.54 p. m.	23 57 00	74 36 30	535	Co	77	75	43.8	
892	Feb. 27	1.56 p. m.	23 50 00	74 38 00	1,264	wh. S. Co	77	76	38.2	
893	Feb. 27	3.17 p. m.	23 43 00	74 39 30	1,263	lt. br. Oz	79	77	38.2	
894	Mar. 8	7.07 a. m.	23 37 20	74 57 40	850	Co. S	78	75	39.1	
895	Mar. 8	8.16 a. m.	23 42 20	74 59 30	657	Co. S	78	75	40.1	
896	Mar. 8	8.49 a. m.	23 44 35	75 01 35	1,017	Co. S	78	75	38.7	
897	Mar. 8	9.40 a. m.	23 46 30	75 03 50	578	Co. S	78	75	42.3	
898	Mar. 8	10.38 a. m.	23 49 30	75 08 30	115	wh. Co. S	75	73	67.8	
899	Mar. 8	3.44 p. m.	23 55 20	75 11 20	845	Co. S. bk. Sp	74	75	39.2	
900	Mar. 8	4.49 p. m.	24 01 20	75 13 30	741	wh. S. rd. and bk. Sp. For	73	75	39.5	
901	Mar. 8	5.54 p. m.	24 08 30	75 15 00	22	wh. S. Sp. and brk. Sh	73	74	74.3	
902	Mar. 8	7.36 p. m.	24 09 00	75 06 00	2,194	br. M. Co. S	72	74	37.2	
903	Mar. 8	10.18 p. m.	24 08 00	74 56 30	2,482	br. Oz	72	74	36.7	
904	Mar. 9	12.56 a. m.	24 08 00	74 45 00	2,255	br. Oz	72	74	36.5	
905	Mar. 9	3.20 a. m.	24 07 00	74 38 00	2,061	br. Oz	72	74	36.7	
906	Mar. 9	3.41 p. m.	23 35 00	74 47 30	149	Co. S. Sh	78	75	65.1	

907	Mar. 10	8.14 a. m	23 37 00	75 06 30	1,398	Co. S	71	74	38.4	
908	Mar. 10	10.17 a. m	23 46 30	75 13 45	1,338	Co. S	72	74	38.2	
909	Mar. 10	12.08 p. m	23 43 45	75 20 45	448	Co. S	72	74	48.3	
910	Mar. 10	1.23 p. m	23 50 30	75 23 30	1,047	Co. S	69	73	38.5	
911	Mar. 10	2.48 p. m	23 56 30	75 26 30	1,211	Co. S	68	73	38.3	
912	Mar. 10	4.18 p. m	24 02 45	75 29 00	361	Co. S	69	73	54.3	
913	Mar. 10	5.05 p. m	24 06 30	75 30 45	273	hrd. Co. S	70	73	n. t.	
914	Mar. 11	10.46 a. m	24 07 00	75 32 30	515	Co. S	68	72	n. t.	
915	Mar. 11	12.13 p. m	24 01 15	75 38 45	1,051	Co. S. bk. Sp	67	72	38.6	
916	Mar. 11	1.42 p. m	23 55 20	75 45 10	1,056	Co. S	68	73	38.6	
917	Mar. 11	3.03 p. m	23 49 30	75 51 40	974	Co. S. bk. Sp	68	73	39.1	
918	Mar. 11	4.20 p. m	23 43 30	75 58 00	124	Co. S	69	73	68.3	
919	Mar. 11	5.44 p. m	23 52 00	76 00 15	863	gy. Oz	67	73	39.1	
920	Mar. 11	7.42 p. m	24 00 40	76 02 45	967	wh. Co. S	66	73	38.6	
921	Mar. 11	9.43 p. m	24 09 00	76 05 00	990	wh. Co. S	66	72	38.6	
922	Mar. 11	11.35 p. m	24 17 20	76 07 30	1,002	wh. Co. S	66	72	38.6	
923	Mar. 12	1.37 a. m	24 25 40	76 09 50	971	gy. Oz	64	69	38.6	
924	Mar. 12	3.43 a. m	24 33 40	76 11 20	937	gy. Oz	65	71	38.6	
925	Mar. 12	5.47 a. m	24 39 40	76 13 50	781	Co. S	66	68	39.0	
926	Mar. 13	2.31 a. m	24 36 30	76 12 00	899	Co. S	72	71	39.0	
927	Mar. 13	4.11 a. m	24 33 00	76 24 30	923	Co. S	73	71	38.6	
928	Mar. 13	5.50 a. m	24 29 00	76 31 15	801	wh. Oz	73	72	39.1	
929	Mar. 13	7.18 a. m	24 25 00	76 37 00	143	wh. Oz	73	72	70.2	
930	Mar. 13	8.21 a. m	24 33 00	76 35 30	842	Co. S	76	73	38.8	No current.
931	Mar. 13	9.41 a. m	24 41 30	76 33 45	861	Co. S	80	74	38.8	Do.
932	Mar. 13	11.02 a. m	24 49 20	76 32 15	764	Co. S	80	74	39.1	Do.
933	Mar. 13	11.58 a. m	24 52 30	76 31 30	325	gy. Oz	78	74	56.2	Do.
934	Mar. 13	8.43 p. m	24 35 20	76 02 45	476	wh. Oz	75	74	46.5	Do.
935	Mar. 13	9.37 p. m	24 38 20	76 01 45	926	wh. Oz	75	74	n. t.	Strong northeast.
936	Mar. 13	11.28 p. m	24 46 50	75 55 45	1,965	gy. Oz	74	73	36.7	
937	Mar. 14	1.45 a. m	24 51 30	75 49 20	2,432	br. Oz	75	73	36.7	No current.
938	Mar. 14	4.22 a. m	25 02 45	75 43 00	2,664	br. Oz	75	73	36.7	Do.
939	Mar. 14	1.23 p. m	25 35 00	76 35 15	11	Co. S	71	72	n. t.	Do.
940	Mar. 14	1.36 p. m	25 35 30	76 34 30	14	Co. S	71	72	n. t.	Do.
941	Mar. 14	1.55 p. m	25 36 30	76 34 45	29	Co. S. rd. Sp	71	72	n. t.	Do.
942	Mar. 14	2.08 p. m	25 37 15	76 34 00	139	hrd. Co	71	72	n. t.	
943	Mar. 14	3.05 p. m	25 40 15	76 29 15	1,927	Co. S	73	72	38.1	North-northwest, $\frac{3}{4}$ knot.
944	Mar. 14	5.10 p. m	25 44 45	76 23 15	2,663	br. Oz	72	72	36.7	North-northwest, $\frac{1}{2}$ knot.
945	Mar. 24	6.30 a. m	25 07 00	77 21 30	375	Co. S	69	72	n. t.	No current.
946	Mar. 24	8.02 a. m	25 15 30	77 24 45	1,409	br. Oz. Co	71	73	38.4	West by north, 2 knots.
947	Mar. 24	10.05 a. m	25 25 30	77 27 50	1,490	br. Oz	70	74	39.1	No current.
948	Mar. 24	1.03 p. m	25 35 30	77 27 45	1,079	hrd. Co. S	69	74	39.1	South, $1\frac{1}{4}$ knots.
949	Mar. 24	3.51 p. m	25 47 00	77 20 30	1,164	hrd. Co. S	68	74	38.6	South, $\frac{3}{4}$ knot.
950	Mar. 24	10.34 p. m	25 53 15	77 33 00	1,312	gy. Oz	65	71	38.4	Do.
951	Mar. 25	4.03 a. m	25 59 00	78 12 00	411	gy. Oz	66	71	49.8	
952	Mar. 25	6.49 a. m	26 04 00	78 29 00	383	br. and gy. Oz	69	74	51.8	No current.
953	Mar. 25	8.55 a. m	26 07 00	78 45 30	281	wh. Oz	69	75	58.3	Do.
954	Apr. 3	9.33 p. m	24 14 00	81 30 00	145	brk. Sh	72	73	46.3	
955	Apr. 3	11.02 p. m	24 05 45	81 30 30	445	wh. Oz	72	75	41.6	East-northeast.
956	Apr. 4	12.56 a. m	23 58 30	81 31 00	589	gy. S. yl. Sp	72	75	40.5	East-northeast, 1 knot.
957	Apr. 4	2.42 a. m	23 51 00	81 31 45	980	gy. S. bk. Sp	73	76	39.9	North-northeast, 2 knots.
958	Apr. 4	5.00 a. m	23 43 00	81 32 15	777	br. Oz	73	76	39.6	Do.

Record of hydrographic soundings, &c.—Continued.

Serial number.	Date.	Hour.	Position.						Depth.	Character of bottom.	Temperatures.			Current.
			Lat. N.			Long. W.					Air.	Surface.	Bottom.	
	1886.		°	′	″	°	′	″	*Fathoms.*		°	°	°	
959	Apr. 4	6.43 a. m	23	35	30	81	32	45	815	lt. br. Oz	74	76	39.6	No current.
960	Apr. 4	8.25 a. m	23	28	00	81	33	15	792	lt. br. Oz	74	77	39.6	Do.
961	Apr. 4	10.03 a. m	23	20	30	81	33	45	707	br. Oz	73	77	40.6	Do.
962	Apr. 4	11.51 a. m	23	13	00	81	34	30	398	br. Oz. Sh	76	77	50.0	
963	Apr. 4	12.36 p. m	23	08	00	81	35	30	261	br. S. Sh	76	77	56.7	
964	Apr. 10	4.50 a. m	26	21	00	78	50	45	443	wh. Oz	68	76	48.4	
965	Apr. 10	7.02 a. m	26	27	00	78	38	00	290	br. S. brk. Sh	70	74	60.6	
966	Apr. 10	9.16 a. m	26	25	30	78	27	50	528	br. S	70	73	40.7	West-northwest, 1 knot.
967	Apr. 10	11.33 a. m	26	31	30	78	21	00	367	yl. M	70	73	53.0	Do.
968	Apr. 10	12.18 p. m	26	33	00	78	24	20	18	Co. S	71	73	73.2	
969	Apr. 10	12.26 p. m	26	32	30	78	24	00	148	Co. S	71	73	n. t.	
970	Apr. 10	1.20 p. m	26	36	30	78	18	30	18	Co	71	73	74.7	
971	Apr. 10	2.24 p. m	26	38	30	78	14	00	274	Co. lt. br. Oz	71	74	62.3	
972	Apr. 10	4.23 p. m	26	39	00	78	09	00	157	gy. Oz	72	74	67.2	
973	Apr. 10	5.04 p. m	26	38	45	78	00	00	10	gy. S. fne. Sh	71	73	n. t.	
974	Apr. 10	5.52 p. m	26	34	00	77	58	45	234	gy. Oz	71	73	63.8	
975	Apr. 10	7.35 p. m	26	22	00	78	08	00	867	wh. Oz	70	73	39.6	
976	Apr. 10	10.16 p. m	26	16	00	77	55	00	711	br. Oz	69	73	39.6	
977	Apr. 12	9.17 p. m	23	39	15	76	47	00	740	wh. Oz	74	74	39.6	North, slight.
978	Apr. 12	11.08 p. m	23	44	00	77	00	00	756	wh. Oz	73	74	40.2	
979	Apr. 13	12.55 a. m	23	49	00	77	13	00	769	wh. Oz	73	74	39.4	
980	Apr. 13	3.12 a. m	23	50	00	77	25	30	740	lt. br. Oz	73	73	39.6	
981	Apr. 13	4.43 a. m	23	58	00	77	20	00	805	lt. br. Oz	73	73	39.4	
982	Apr. 13	6.18 a. m	23	57	00	77	12	15	514	lt. br. Oz	73	73	40.4	
983	Apr. 13	2.22 p. m	24	07	00	77	21	00	809	wh. Oz	82	74	57.3	
984	Apr. 13	3.54 p. m	24	13	00	77	30	30	822	lt. br. Oz	78	74	39.4	
985	Apr. 13	5.20 p. m	24	19	30	77	24	30	852	lt. br. Oz	70	74	47.6	
986	Apr. 13	6.46 p. m	24	25	00	77	18	15	639	wh. M	74	74	59.8	
987	Apr. 14	5.35 a. m	24	29	30	77	19	00	444	wh. M	72	73	45.7	
988	Apr. 14	7.28 a. m	24	37	00	77	30	00	939	Co. M	80	73	39.1	
989	Apr. 14	9.28 a. m	24	43	00	77	42	00	734	lt. br. Oz	76	74	39.6	
990	Apr. 14	7.01 p. m	25	19	30	77	57	30	959	lt. br. Oz	71	73	38.6	
991	Apr. 15	7.23 a. m	25	11	00	77	47	30	1,195	lt. br. Glob. Oz	69	73	40.7	
992	Apr. 15	9.23 a. m	25	02	30	77	40	00	1,084	yl. M	74	73	39.8	
993	Apr. 17	7.42 a. m	25	06	00	77	32	00	794	Co. S	72	73	39.4	South, ½ knot.
994	Apr. 30	12.12 p. m	25	35	45	76	57	00	1,527	lt. br. Oz	79	76	44.2	
995	Apr. 30	1.39 p. m	25	39	30	76	53	45	1,982	wh. Co. Oz	79	76	36.9	
996	Apr. 30	3.10 p. m	25	43	00	76	58	00	2,222	br. Oz	79	76	39.1	
997	Apr. 30	4.55 p. m	25	47	00	77	03	00	1,773	gy. S. bk. Sp	77	76	37.0	

998	Apr. 30	6.25 p. m	25 50 45	77 09 00	11½	No specimen	77	76	n. t.	
999	May 1	1.51 a. m	26 40 00	76 49 30	942	brk. Sh	75	77	39. 1	
1000	May 1	3.47 a. m	26 43 00	76 38 30	2, 800	br. Oz	75	77	36. 8	East by south, ½ knot.
1001	May 1	6.55 a. m	26 45 00	76 26 00	2, 764	gy. Co. S	77	76	38. 1	Do.
1002	May 1	9.42 a. m	26 47 00	76 15 00	2, 693	br. Co. S	76	74	38. 4	
1003	May 1	12 m	26 50 00	76 04 45	2, 670	br. Oz	76	74	38. 1	
1004	May 1	4.36 p. m	27 11 00	76 19 00	2, 715	Co. S. For	76	73	38. 1	
1005	May 2	12.06 a. m	27 41 00	76 41 00	943	gy. Oz. bk. Sp	69	72	38. 6	
1006	May 2	2.18 a. m	27 45 00	76 52 30	671	yl. Oz. bk. Sp	69	72	41. 1	North, ½ knot.
1007	May 2	4.18 a. m	27 49 00	77 04 00	690	yl. Oz. bk. Sp.	69	72	41. 1	
1008	May 2	6.15 a. m	27 53 00	77 16 00	669	yl. Oz. bk. Sp	71	73	39. 9	
1009	May 2	11.13 a. m	27 49 30	77 35 00	661	Co. S. For	72	73	......	
1010	May 2	12.57 p. m	27 42 30	77 45 00	663	lt. br. Oz	74	74	40. 5	
1011	May 2	2.30 p. m	27 35 45	77 51 00	682	Wire parted, lost 400 turns, ther., and lead	74	74	......	
1012	May 2	3.59 p. m	27 27 00	77 59 00	610	wh. S	74	74	40. 8	
1013	May 5	4.35 p. m	31 27 00	79 12 00	280	crs. gy. S	76	77	50. 2	
1014	July 18	3.05 a. m	39 57 00	71 24 45	58	br. S. Sh	72	71	53. 1	
1015	July 18	3.43 a. m	39 54 00	71 24 00	119	gn. M	72	71	51. 0	
1016	July 18	5.26 a. m	39 50 00	71 20 30	226	gn. M	72	71	43. 1	
1017	Aug. 3	2.10 p. m	40 14 00	65 56 00	2, 224	br. Oz. C	68	75	36. 7	
1018	Aug. 3	6.22 p. m	40 15 00	65 35 00	2, 951	br. Oz	68	74	36. 2	
1019	Aug. 4	1 a. m	40 20 00	64 54 00	2, 575	gy. and br. Oz	68	73	37. 3	Northwest, 1 knot.
1020	Aug. 4	6.40 a. m	40 52 24	63 53 00	2, 337	lt. br. Oz	67	73	......	
1021	Aug. 4	12.27 p. m	41 29 28	63 27 30	1, 919	lt. br. Oz	70	66	37. 5	Northwest, 1 knot.
1022	Aug. 4	1.50 p. m	41 29 28	63 21 00	1, 932	lt. br. Oz	69	64	37. 7	Do.
1023	Aug. 4	3.04 p. m	41 29 28	63 17 00	1, 969	lt. br. Oz	68	64	37. 3	Do.
1024	Aug. 4	4.35 p. m	41 29 28	63 10 15	1, 980	lt. br. Oz	69	64	37. 3	East-northeast, 1 knot.
1025	Aug. 4	6.02 p. m	41 29 28	63 05 15	1, 996	lt. br. Oz	65	66	......	East, 1 knot.
1026	Aug. 4	7.37 p. m	41 25 30	63 08 00	2, 025	lt. br. Oz	65	66	36. 2	
1027	Aug. 4	10.44 p. m	41 24 00	63 19 00	2, 033	lt. br. Oz	66	65	36. 3	
1028	Aug. 5	1.03 a. m	41 22 20	63 29 30	2, 054	lt. br. Oz	65	66	36. 2	
1029	Aug. 5	3.11 a. m	41 31 00	63 27 30	1, 930	lt. br. Oz	65	66	36. 2	
1030	Aug. 5	4.45 a. m	41 30 30	63 15 00	1, 978	lt. br. Oz	64	63	36. 2	
1031	Aug. 5	6.22 a. m	41 32 30	63 00 30	2, 033	lt. br. Oz	62	64	36. 3	
1032	Aug. 5	8.19 a. m	41 29 30	62 47 30	2, 069	lt. br. Oz	62	64	36. 2	
1033	Aug. 5	12.31 p. m	41 53 00	62 35 15	1, 708	No specimen	67	67	......	
1034	Aug. 5	4.47 p. m	42 21 00	62 18 00	1, 138	br. Oz	69	66	38. 2	Northeast by east, 2 knots.
1035	Aug. 5	8.48 p. m	42 43 00	62 03 00	231	gy. S. bk. Sp	67	64	40. 8	
1036	Aug. 6	8.44 p. m	43 30 00	57 40 00	1, 731	lt. br. Oz	64	62	37. 2	East-northeast, 1 knot.
1037	Aug. 7	4.37 a. m	43 45 00	56 09 00	1, 758	stk. br. M	62	62	37. 2	
1038	Aug. 7	12.38 p. m	44 02 00	54 39 00	1, 780	lt. gy. M	66	64	36. 9	East, ½ knot.
1039	Aug. 7	6.43 p. m	44 13 00	53 47 00	1, 172	br. Oz	63	63	37. 7	East, 1 knot.
1040	Aug. 8	12.03 a. m	44 23 00	52 42 00	81	For. bk. Sp	61	62	31. 9	
1041	Aug. 8	12 m	44 52 00	50 25 24	34	rd. S. bk. Sp	62	62	39. 7	
1042	Aug. 8	6.12 p. m	45 00 00	49 15 00	35	wh. S. brk. Sh	60	62	31. 1	
1043	Aug. 8	6.54 p. m	45 00 00	49 09 00	35	hrd	60	62	31. 0	
1044	Aug. 8	7.27 p. m	45 00 00	49 03 00	35	wh. S	57	59	30. 9	
1045	Aug. 8	8.03 p. m	45 00 00	48 57 00	38	P	57	58	31. 4	
1046	Aug. 8	8.39 p. m	45 00 00	48 51 00	41	P. wh. S. brk. Sh	57	58	30. 4	
1047	Aug. 8	9.13 p. m	45 00 00	48 45 00	115	crs. wh. S. brk. Sh	57	56	31. 9	
1048	Aug. 8	11.43 p. m	45 02 00	48 20 00	1, 169	lt. br. Oz	57	56	37. 8	
1049	Aug. 9	6.47 a. m	45 02 00	47 08 00	1, 916	lt. br. Oz	62	59	38. 2	East, 1 knot.

Record of hydrographic soundings, &c.—Continued.

Serial number.	Date.	Hour.	Position. Lat. N.			Position. Long. W.			Depth.	Character of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Current.
	1886.		°	′	″	°	′	″	*Fathoms.*		°	°	°	
1050	Aug. 9	1.32 p. m	45	02	00	45	58	00	1,981	br. Oz	65	62	36.3	
1051	Aug. 9	7.56 p. m	45	04	00	44	38	00	2,549	br. Oz	65	63	36.2	
1052	Aug. 10	2.40 a. m	45	06	00	43	23	30	2,621	lt. br. Oz	67	68	36.8	North, 1 knot.
1053	Aug. 10	9.30 a. m	45	14	00	42	03	00	2,658	br. Oz. For	69	70	37.8	North-northwest, 1½ knots.
1054	Aug. 10	6.47 p. m	45	43	00	43	00	00	2,577	lt. br. Oz	69	68	36.8	Do.
1055	Aug. 11	3.03 a. m	46	21	00	43	47	00	2,135	S. G	57	60	37.3	Northeast, 1½ knots.
1056	Aug. 11	7.43 p. m	47	02	30	45	06	30	103	hrd	59	58	38.2	
1057	Aug. 11	9.20 p. m	47	14	00	45	31	30	155	wh. S. bk. Sp	58	57	39.7	
1058	Aug. 12	1.51 a. m	47	27	00	46	11	30	423	br. Oz	56	57	38.7	
1059	Aug. 12	6.58 a. m	47	32	12	46	53	30	477	No specimen	53	49	....	
1060	Aug. 12	4.37 p. m	47	44	00	48	12	30	170	gy. S. P	55	50	37.1	Southerly, ½ knot.
1061	Aug. 12	5.21 p. m	47	46	00	48	19	30	168	gy. S. bk. Sp	55	51	36.5	Do.
1062	Aug. 12	7.17 p. m	47	49	00	48	41	30	147	gy. S. bk. Sp. brk. Sh	54	51	35.2	
1063	Aug. 13	12.14 a. m	47	57	00	49	24	30	106	gy. S. bk. Sp	54	52	32.4	
1064	Aug. 13	3.48 a. m	48	02	00	50	10	30	100	gy. M	55	53	30.4	
1065	Aug. 13	7.58 a. m	47	31	00	50	17	00	62	gy. S. bk. Sp. P	56	54	30.1	
1066	Aug. 13	11.31 a. m	47	26	00	51	00	30	74	fne. gy. S. bk. Sp	57	54	....	
1067	Aug. 13	2.57 p. m	47	30	00	51	45	00	98	gn. M	55	55	....	
1068	Aug. 22	8.55 p. m	44	40	00	56	43	30	226	gy. M	60	58	40.4	
1069	Aug. 22	11.43 p. m	44	31	00	57	09	00	38	gy. S. P	60	58	33.7	
1070	Aug. 23	7.23 a. m	44	25	00	57	35	00	32	wh. S. bk. Sp	63	59	....	
1071	Aug. 23	3.44 p. m	43	38	00	59	18	30	63	gy. S. bk. Sp	67	62	35.6	
1072	Aug. 25	8.02 a. m	41	37	00	62	58	00	1,943	dk. br. Oz	63	65	36.9	Southeast, 2 knots.
1073	Aug. 25	9.33 a. m	41	37	00	63	05	00	1,854	dk. br. Oz	63	68	36.7	Do.
1074	Aug. 25	10.58 a. m	41	37	00	63	11	30	1,798	dk. br. Oz	63	65	37.2	Southeast, 1½ knots.
1075	Aug. 25	12.21 p. m	41	37	00	63	18	00	1,779	dk. br. Oz	64	65	37.1	East, 2 knots.
1076	Aug. 25	1.53 p. m	41	37	00	63	26	00	1,762	dk. br. Oz	70	73	36.9	Do.
1077	Aug. 25	3.15 p. m	41	37	00	63	34	00	1,741	dk. br. Oz	70	73	36.9	
1078	Aug. 25	4.35 p. m	41	42	00	63	34	00	1,644	dk. br. Oz	70	72	37.2	
1079	Aug. 25	6.01 p. m	41	42	00	63	27	00	1,693	dk. br. Oz	70	72	36.9	
1080	Aug. 25	7.28 p. m	41	42	00	63	21	00	1,697	dk. br. Oz	70	72	36.9	
1081	Aug. 25	9.05 p. m	41	42	00	63	14	30	1,713	lt. br. Oz. For	70	71	37.5	Easterly, 2 knots.
1082	Aug. 26	12.29 p. m	41	49	00	63	50	00	1,587	br. Oz. gy. M	73	73	37.5	
1083	Aug. 26	2.09 p. m	41	42	00	63	47	30	1,620	br. Oz. For	74	73	37.2	East by north, 2 knots.
1084	Aug. 26	3.34 p. m	41	37	00	63	45	00	1,699	br. Oz. For	74	74	37.2	
1085	Aug. 26	4.59 p. m	41	32	00	63	43	00	1,805	br. Oz. For	74	74	36.7	
1086	Aug. 26	6.26 p. m	41	26	00	63	40	45	1,910	br. Oz. For	74	73	36.7	
1087	Aug. 26	8.29 p. m	41	27	00	63	54	30	1,880	lt. br. Oz	70	73	36.7	
1088	Aug. 27	12.26 a. m	41	27	00	64	22	30	1,879	lt. br. Oz. For	67	72	36.7	Northwest, 2 knots.
1089	Aug. 27	4.10 a. m	41	28	00	64	51	30	1,696	No specimen	68	72	....	

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, from January 1 to October 26, 1886.

[For the record of Albatross dredging stations preceding that herewith presented, reference should be made as follows: Nos. 2001-2116, pages 219-221, Fish Commission Report for 1883; Nos. 2117-2310, pages 106-110, Fish Commission Report for 1884; Nos. 2311-2628, pages 66-73, Fish Commission Report for 1885.]

Serial number.	Date.	Hour.	Position. Lat. N.	Position. Long. W.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Instrument used.
	1886.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2629	Mar. 8	12.07 p. m	23 48 40	75 10 40	73	73	38.4	1,169	Co. S	N.	1	S. by W. $\frac{3}{4}$ W.	$2\frac{1}{2}$	L. B. T.
2630	Mar. 12	2.10 p. m	24 39 45	76 11 30	72	72	61.8	244	Co. S	SE.	4	ESE.	$\frac{1}{4}$	Tgls.
2631	Mar. 12	3.03 p. m	24 39 30	76 11 00	73	72	59.8	280	Co. S	SE.	4	NNW.	$\frac{1}{8}$	Tgls.
2632	Mar. 13	2.29 p. m	24 30 43	76 23 45	75	73	39.4	791	Co. S. gy. Oz	SSE.	4	E. by N.	2	L. B. T.
2633	Apr. 7	8.05 a. m	23 11 00	82 19 30	74	76	60.8	208	Co. S	NE.	3	......	......	Tgls.
2634	Apr. 7	8.48 a. m	23 10 45	82 18 45	74	76	......	162	br. S. brk. Sh	NE.	3	......	......	Tgls.
2635	Apr. 7	10.05 a. m	23 10 55	82 18 55	71	73	62.8	208	dead Co. Sh	N. by E.	3	......	......	Tgls.
2636	Apr. 7	10.52 a. m	23 10 45	82 18 45	71	73	62.6	191	dead Co. Sh	N. by E.	3	......	......	Tgls.
2637	Apr. 7	11.32 a. m	23 10 45	82 19 00	70	75	65.8	143	dead Co. Sh	N. by E.	3	......	......	Tgls.
2638	Apr. 7	2.09 p. m	23 17 45	82 18 00	69	76	39.6	1,025	yl. S	N.	3	......	......	L. B. T.
2639	Apr. 9	6.05 a. m	25 04 50	80 15 10	70	73	......	56	Co. S	NE.	4	NE. by N.	$\frac{1}{4}$	Bl. Dr.
2640	Apr. 9	6.33 a. m	25 05 00	80 15 00	70	73	......	56	Co. S	NE.	4	NE. by N.	$\frac{1}{4}$	L. B. T.
2641	Apr. 9	8.14 a. m	25 11 30	80 10 00	70	74	69.2	60	Co. S	NE.	4	NE. by N.	$\frac{1}{4}$	L. B. T.
2642	Apr. 9	10.41 a. m	25 20 30	79 58 00	71	74	42.6	217	gy. S	NE. by E.	4	NE. by N.	1	L. B. T.
2643	Apr. 9	11.54 a. m	25 25 00	79 55 15	71	74	43.1	211	gy. S	NE. by E.	4	NE. by N.	$1\frac{1}{2}$	L. B. T.
2644	Apr. 9	2.01 p. m	25 40 00	80 00 00	73	73	43.4	193	gy. S	NNE.	3	N. $\frac{3}{4}$ W.	$\frac{3}{4}$	Bl. Dr.
2645	Apr. 9	3.15 p. m	25 46 30	80 02 00	70	75	43.4	157	gn. S	NNE.	3	......	......	Bl. Dr.
2646	Apr. 9	4.14 p. m	25 47 00	80 05 00	71	75	......	85	gy. S. For	NNE.	3	N.	$\frac{1}{2}$	Bl. Dr.
2647	Apr. 9	4.49 p. m	25 48 00	80 04 00	71	75	......	85	gy. S. For	NNE.	3	N.	$\frac{1}{2}$	Bl. Dr.
2648	Apr. 9	5.17 p. m	25 53 00	80 03 30	71	73	......	84	gn. M	NNE.	3	N.	$\frac{1}{2}$	Bl. Dr.
2649	Apr. 12	5.25 p. m	23 34 00	76 33 00	73	74	74.2	36	Co. S	SE.	6	......	......	Tgls.
2650	Apr. 12	6.01 p. m	23 34 30	76 34 00	73	74	57.8	369	Co. S. wh. Oz	SE.	6	SE. by E.	2	Tgls.
2651	Apr. 13	9.46 a. m	24 02 00	77 12 45	75	74	73.4	97	wh. Oz	E.	4	......	......	Tgls.
2652	Apr. 13	10.06 a. m	24 12 30	77 13 00	75	74	67.1	140	wh. M	E.	4	......	......	Bl. Dr.
2653	Apr. 14	11.35 a. m	24 52 30	77 39 00	78	74	39.1	1,000	lt. br. Oz	N.	3	NW. by W.	3	L. B. T.
2654	May 2	8.29 a. m	27 57 30	77 27 30	76	73	39.3	660	yl. Oz. bk. Sp	WNW.	2	NW. by W.	1	L. B. T.
2655	May 2	5.49 p. m	27 22 00	78 07 30	72	76	47.5	338	gy. S	NW.	3	NW. by W.	$\frac{3}{4}$	L. B. T.
2656	May 3	5.24 a. m	27 58 30	78 24 00	69	71	41.2	572	For	N.	3	WNW.	$1\frac{1}{2}$	L. B. T.
2657	May 3	8.35 a. m	28 08 00	78 28 00	71	73	44.7	540	For	N.	3	WNW.	$1\frac{3}{4}$	L. B. T.
2658	May 3	12.20 p. m	28 21 00	78 33 00	72	73	44.7	514	For. brk. Sh	N. by E.	3	NNW. $\frac{1}{2}$ W.	$1\frac{1}{4}$	L. B. T.
2659	May 3	3.35 p. m	28 32 00	78 42 00	73	74	45.2	509	br. For	N.	3	NW.	1	L. B. T.
2660	May 3	6.47 p. m	28 40 00	78 46 00	72	74	45.7	504	yl. For	NNE.	3	NW.	$\frac{1}{4}$	L. B. T.
2661	May 4	5.29 a. m	29 16 30	79 36 30	70	75	45.5	438	gy. S. bk. Sp	ENE.	4	NNW.	1	L. B. T.
2662	May 4	8.19 a. m	29 24 30	79 43 00	72	75	43.7	434	gy. S. brk. Sh	ENE.	4	NNW.	$\frac{3}{4}$	L. B. T.

Record of dredgings and trawlings, &c.—Continued.

Serial number.	Date.	Hour.	Position. Lat. N.	Position. Long. W.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Instrument used.
	1886.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2663	May 4	10.46 a. m	29 39 00	79 49 00	72	77	42.7	421	br. S	E.	4	NNW.	¾	L. B. T.
2664	May 4	2.26 p. m	29 41 00	79 55 00	74	75	42.7	373	Co. S	E.	2	N.	1	L. B. T.
2665	May 4	5.16 p. m	29 47 00	80 05 45	75	76	45.2	263	fne. gy. S	ESE.	3	SSE.	¾	L. B. T.
2666	May 5	5.26 a. m	30 47 30	79 49 00	70	74	48.3	270	gy. S	E.	1	NNE.	1¼	L. B. T.
2667	May 5	7.22 a. m	30 53 00	79 42 30	75	75	48.7	273	gy. S. bk. Sp	E.	2	NNE.	¾	L. B. T.
2668	May 5	9.37 a. m	30 58 30	79 38 30	73	76	46.3	294	gy. S. dd. Co	E.	2	NNE.	¼	L. B. T.
2669	May 5	11.23 a. m	31 09 00	79 33 30	73	77	43.7	352	gy. S. dd. Co	E.	2	NNE.	¼	L. B. T.
2670	May 5	1.52 p. m	31 20 00	79 22 00	73	74	44.5	280	gy. S. dd. Co	E.	1			L. B. T.
2671	May 5	2.45 p. m	31 20 00	79 22 00	76	77		280	gy. S. dd. Co	E. by S.	1			Tgls.
2672	May 5	5.55 p. m	31 31 00	79 05 00	73	77	54.3	277	crs. br. S	SE.	1	NE. by E.	¼	Tgls.
2673	May 6	5.17 a. m	32 26 00	77 43 30	72	77	51.6	240	Co. gy. S. bk. Sp	SW.	1	NE. by E.	½	L. B. T.
2674	May 6	8.45 a. m	32 32 00	77 17 00	72	76	46.0	316	gy. S. bk. Sp. Sh	SW.	2	E.	1½	L. B. T.
2675	May 6	10 a. m	32 32 30	77 15 00	73	75	45.8	327	gy. S. bk. Sp. Sh	SW.	2	E.	1	L. B. T.
2676	May 6	12.19 p. m	32 39 00	77 01 00	73	77	45.8	407	gn. Oz. gy. S	SW.	2	E.	1	L. B. T.
2677	May 6	2.49 p. m	32 39 00	76 50 30	75	78	39.3	478	gn. M	SW.	2	E.	1¼	L. B. T.
2678	May 6	5.42 p. m	32 40 00	76 40 30	74	77	38.7	731	lt. gy. Oz	SSW.	3	SSW.	1	L. B. T.
2679	May 6	8.14 p. m	32 40 00	76 40 30	72	75	38.6	782	lt. gy. Oz	SSW.	3	SW.	1½	L. B. T.
2680	July 16	9.27 a. m	39 50 00	70 26 00				555	No specimen	S. by E.	5	SSE. ¼ E.	½	L. B. T.
2681	July 16	12.55 p. m	39 43 00	70 29 00				990	gn. M	S.	4	SE.	1	L. B. T.
2682	July 16	5.28 p. m	39 38 00	70 22 00				1,004	gn. M. S	WSW.	3	SE. by E.	1½	L. B. T.
2683	July 17	5.04 a. m	39 33 00	70 50 00				887	br. Oz	SSW.	2	SE. by S.	1	L. B. T.
2684	July 17	8.18 a. m	39 35 00	70 54 00				1,106	br. C. bk. Sp	SSW.	1	SSE.	1½	L. B. T.
2685	July 17	1.59 p. m	39 35 00	71 02 30				1,137	gn. M. wh. Sp	Calm.	0	S.	1½	L. B. T.
2686	July 18	4.31 a. m	39 52 00	71 20 45				226	gn. M	SW.	2	W.	¾	L. B. T.
2687	July 18	6.12 a. m	39 46 00	71 19 00				326	gn. M	SW.	1	W.	¾	L. B. T.
2688	July 18	8.17 a. m	39 42 00	71 12 00				644	gn. M	SW.	1	SW. by W.	1	L. B. T.
2689	July 18	10.18 a. m	39 42 00	71 15 30				525	gn. M	SSW.	1	NW.	2	L. B. T.
2690	July 18	1.12 p. m	39 39 00	71 11 00				643	gn. M	Calm.	0	SW.	1	L. B. T.
2691	July 18	5.18 p. m	39 37 00	71 08 00				835	lt. gn. M	SSW.	2	NW.	1½	L. B. T.
2692	Aug. 11	10.49 a. m	46 50 00	44 35 00				73	gy. S. sml. bk. St	NW.	3	W. by S.	½	L. B. T.
2693	Aug. 11	12.09 p. m	46 53 00	44 39 30				78	rd. and gn. S. bk. and gy. P	NW.	2	W. by S	1¼	L. B. T.
2694	Aug. 11	1.55 p. m	46 52 30	44 54 30				86	gy. S. bk. Sp	WSW.	3	WNW.	¼	L. B. T.
2695	Aug. 11	3.44 p. m	46 51 30	45 06 30				105	gy. S. bk. Sp. P	W.	3	NE.	½	L. B. T.
2696	Aug. 11	4.33 p. m	46 53 30	45 05 30				98	gy. S. bk. Sp	W.	3	NE.	½	L. B. T.
2697	Aug. 12	12.09 p. m	47 40 00	47 35 30				206	gn. M. bk. Sp	SSW.	2	SW. by S.	½	L. B. T.
2698	Aug. 22	8.10 a. m	45 07 00	55 09 00				90	gy. S. bk. Sp. P	SSW.	2	S. by W.	¼	L. B. T.
2699	Aug. 22	10.53 a. m	45 04 00	55 23 00				72	Co	WSW.	2	E. ¾ S.	½	L. B. T.

2700	Aug. 22	1.29 p. m	44 56 30	55 48 00				59	gy. S. bk. Sp	SW.	2	E. ¾ S.	½	L. B. T.
2701	Aug. 22	2.02 p. m	44 56 00	55 49 30				75	gy. S. bk. Sp	S.	2	E. ¼ S.	½	L. B. T.
2702	Aug. 22	5.25 p. m	44 50 00	56 19 30				215	gn. M	S.	3	W.	¾	L. B. T.
2703	Aug. 23	11.30 a. m	44 01 00	59 02 30				140	gy. S. bk. Sp	S. by W.	4	WSW.	½	L. B. T.
2704	Aug. 23	4.52 p. m	43 32 00	59 22 00				110	gy. S. bk. Sp	SW. by S.	6	WNW. ¼ W.	¾	L. B. T.
2705	Aug. 24	9.11 a. m	42 47 00	61 04 00				1,255	lt. br. Oz	N.	1	N. by E. ½ E.	2½	L. B. T.
2706	Aug. 27	9.33 a. m	41 28 30	65 35 30				1,188	gy. Oz. For	SE.	2	SW.	1½	L. B. T.
2707	Aug. 27	2.21 p. m	41 24 00	65 48 00				1,099	br. Oz. For	WSW.	3	SW. by W.	1½	L. B. T.
2708	Aug. 28	7.09 a. m	40 07 00	67 49 00				980	br. Oz	SW. by W.	4	W.	1	L. B. T.
2709	Aug. 28	9.55 a. m	40 07 00	67 54 00				866	br. M	WSW.	2	WNW.	¾	L. B. T.
2710	Aug. 28	2.45 p. m	40 06 00	68 01 30				984	gn. M	SSW.	3			L. B. T.
2711	Sept. 16	3.40 p. m	38 59 00	70 07 00				1,544	Glob. Oz	SE.	4	W.	1½	L. B. T.
2712	Sept. 17	5.49 a. m	38 20 00	70 05 30				1,867	br. Oz	Calm.	0	W.	1½	L. B. T.
2713	Sept. 17	11.20 a. m	38 20 00	70 08 30				1,859	br. Oz	Calm.	0	W.	1½	L. B. T.
2714	Sept. 17	4.58 p. m	38 22 00	70 17 30				1,825	br. Oz	WSW.	1	SW.	1½	L. B. T.
2715	Sept. 18	5.33 a. m	38 29 30	70 54 30				1,753	br. Oz	WSW.	2	WNW.	1½	L. B. T.
2716	Sept. 18	11.04 a. m	38 29 30	70 57 00				1,631	br. Oz. For	NW.	2	NW.	1½	L. B. T.
2717	Sept. 18	3.54 p. m	38 24 00	71 13 00				1,615	br. Oz	NE.	3	NW.	1	L. B. T.
2718	Sept. 19	5.38 a. m	38 24 00	71 52 00				1,569	br. Oz	E.	4	NNW.	2	L. B. T.
2719	Sept. 19	11.13 a. m	38 29 00	71 58 00				1,536	gy. Oz	ESE.	3	NW.	1½	L. B. T.
2720	Sept. 19	3.54 p. m	38 36 30	72 12 00				1,509	gy. Oz	S.	2	NE. by N.	2	L. B. T.
2721	Sept. 20	6.02 a. m	38 56 00	72 11 30				813	gy. Oz	W. by N.	4	NW.	1	L. B. T.
2722	Sept. 20	9.33 a. m	39 13 00	72 01 00				594	gn. M	N. by W.	6	WSW.	3	L. B. T.
2723	Oct. 23	5.42 a. m	36 47 00	73 09 30				1,685	gy. Oz. For	N. by W.	2	W. SW. ¾ W.	1	L. B. T.
2724	Oct. 23	12.02 p. m	36 47 00	73 25 00				1,641	gy. Oz. For	NNW.	2	W. S. W.	2	L. B. T.
2725	Oct. 24	5.54 a. m	36 34 00	73 48 00				1,374	gy. Oz. For	NE.	5	W.	1½	L. B. T.
2726	Oct. 24	11.10 a. m	36 34 00	73 54 30				1,253	gy. Oz	NE.	4	W. by S.	1	L. B. T.
2727	Oct. 24	4.09 p. m	36 35 00	74 03 30				1,239	gy. Oz	ENE.	4	W.	1	L. B. T.
2728	Oct. 25	5.45 a. m	36 30 00	74 33 00				859	gy. Oz	NE. by E.	3	N. W. ⅛ N.	1	L. B. T.
2729	Oct. 25	9.10 a. m	36 36 00	74 32 00				679	dk. gn. M	ENE.	2	NNE.	1	L. B. T.
2730	Oct. 25	12.28 p. m	36 42 00	74 30 00				727	gn. M. For	E.	2	N.	¾	L. B. T.
2731	Oct. 25	4.12 p. m	36 45 00	74 28 00				781	gy. Oz	Calm.	0	N. by E.	1	L. B. T.
2732	Oct. 26	6.09 a. m	37 27 00	73 33 00				1,152	dk. gn. M	SE.	1	W. SW.	1½	L. B. T.
2733	Oct. 26	10.19 a. m	37 26 00	73 43 00				944	gn. M	SE.	2	SW. by W.	2	L. B. T.
2734	Oct. 26	1.52 p. m	37 23 00	73 53 00				841	sft. gn. M	SE.	2	W. SW.	1½	L. B. T.
2735	Oct. 26	4.55 p. m	37 23 00	74 02 00				811	sft. gn. M	SE.	2	SW.	1¼	L. B. T.

87.—REPORT ON THE PACKING OF SALMON ON THE PACIFIC COAST FROM 1883 TO 1886.

By LOREN W. GREEN.

I have lately visited all the salmon canneries on the Sacramento River and seen their agents, for the purpose of obtaining the statistics of the catch of salmon for this and past seasons. Among the results of my visit is a table giving the pack of salmon (in cases, each containing 48 one-pound tin cans) for each river on the Pacific coast for the years 1883, 1884, 1885, and 1886, which is appended to this report. Also I append a table showing the names of the canneries on the Sacramento River, with their locations, brands, and agents at San Francisco.

In the year 1883 but little effort was made to secure all the salmon required, and large numbers were allowed to pass on their way to the headwaters for the purpose of depositing their spawn.

In 1884 a scarcity was noticeable, and immediately seines were enlarged, more boats and men employed, and fishing was carried on generally with greater diligence. But, notwithstanding all the extra exertion employed, the decrease from the pack of 1883 on the Sacramento River alone was 65,000 cases, and the decrease of those reaching the headwaters was, at a moderate estimate, 60 per cent.

In 1885 fishing was again diligently carried on from the beginning to the end of the season, and the decrease from 1884, as seen by the figures given, was 46,500 cases. The number of salmon reaching the headwaters was only about one-half as many as those of the preceding year.

During the present year (1886) the agents have used all available means for securing a large number of fish. As the demand for canned salmon is steadily increasing, upwards of 1,000 boats and 2,000 men were employed in fishing for salmon on the Sacramento River. But it must be stated that matters have been somewhat unfavorable for them in this year's fishing, for in the early spring the water was unusually high, which confined these fishermen more to the bars and allowed a considerable percentage of the first run to pass their seines; also, the California fish commissioners caused a law to be passed prohibiting the fishing with seines after September 1, which was one month sooner than in past seasons. The total number of cases canned for this season was 30,000.

In talking with the agents of the canneries, as well as with those engaged in the fishing, I found them to differ somewhat in opinion as regards the cause of this decrease in salmon. Some believed that the sea-lions are doing great damage in the way of destroying the large salmon as they come in from the ocean on the way to their spawning grounds. Others, that the catfish are very destructive, following the salmon to

their spawning grounds and feeding upon their eggs and young fry, Some hold that the natural spawning grounds are being destroyed by mud and rubbish from mining operations. Another thing proposed as the cause is the excessive and destructive mode of fishing practiced by the Chinese in the Sacramento River. It should be stated also that many people in the upper counties along the Sacramento attribute this decrease of salmon principally to the excessive fishing at the canneries.

I have taken much pains to ascertain the cause of this decrease, and have followed the Sacramento River from the ocean to its headwaters. Beginning with the sea-lions in the Bay of San Francisco, it is safe to say that they destroy a great many large salmon that otherwise would ascend our rivers, but I see no reason for supposing that the number destroyed of late years is in excess of their consumption of previous years.

Taking the catfish into consideration, it is probable that a small percentage of the young fry, as they first rise from their gravelly beds, find their way into the stomachs of these ugly little catfish, yet I think to no alarming extent. In our rivers also, where salmon deposit their eggs on the swift riffles over clean, gravelly beds, I think that very few of these eggs are disturbed by the catfish, which are more inclined to follow the slow, muddy places in the river.

As regards the Chinese, it must be borne in mind that they are not communicative in respect to any matter of business in which they are interested, and they will not knowingly impart any information that may in the slightest degree be utilized by those of other races. Yet by closely inspecting the streams near the locality in which they reside, it is found that they are using a beardless hook, something of their own manufacture and peculiar in shape. Strong lines are placed across the stream or a portion of it, as the case may be. These hooks are fastened to short leaders, which vary in length, and which are suspended from the main line to a depth of 1 foot from the surface to the bottom of the river. Hundreds of hooks are used on a line, and quantities of the larger fish are caught as they endeavor to pass; many more are fatally wounded, but make their escape, only to die in the streams above. They also take many young fish, which are dried and exported to China.

I also found a point of the river, near Sacramento, where many of the young salmon are lost in their downward course to the ocean. It is a well-known fact that for the past few years the bed of the Sacramento River has gradually been rising, caused by hydraulic mining on the streams above, and the filling up of the river has caused an overflowing of its banks during high water. Levees have been constructed to prevent damage of property in the city, and to confine the water to its own channel, but at present many places in the levees are broken, and there are also points some distance above where in high water the river overflows and sinks into a large tract of marsh land. In seasons when the first rise of water, which carries the young salmon down to the ocean,

overflows the banks, a great many of the young fish are carried through the breaks and low places and are left to die by thousands. At other seasons, when the first rise is moderate, they go safely to the ocean through the main channel.

Whatever may be the cause, or the combination of causes, all parties agree in the opinion that artificial hatching and the restocking of our streams is the only means by which the required supply of salmon can be maintained; and that unless measures are taken other than those now in operation the salmon supply in our rivers must soon become exhausted. No artificial hatching has been done, and consequently no young salmon have been planted in our rivers, since the suspension of the United States salmon-breeding station on the McCloud River. The California State hatchery, which was established on Hat Creek in 1885, has thus far been of no use, owing to the fact that salmon do not run there in sufficient numbers to justify the taking of eggs.

UNITED STATES TROUT PONDS,
McCLOUD RIVER STATION,
Baird, Cal., October 4, 1886.

TABLE I.—*Statistics of the packing of salmon on the Pacific coast from 1883 to 1886, showing the total production for each river.*

Locality.*	1883.	1884.	1885.	1886.†
	Cases.	*Cases.*	*Cases.*	*Cases.*
Sacramento River, California‡	160,000	95,000	48,500	30,000
Eel River, California	15,000	8,000	5,700	
Rogue River, Oregon	16,000	12,000	9,100	2,000
Coquille River, Oregon	7,000	7,300	3,800	
Umpqua River, Oregon		3,700	10,500	
Smith's River, Oregon		5,000	1,500	
Tillamook River, Oregon		4,500	9,800	
Columbia River, Oregon and Washington Ter.	629,400	629,000	553,800	521,000
Puget Sound, Washington			48,500	
Fraser River, British Columbia	175,000			
Rivers in British Columbia	§68,000	175,800	106,900	100,000
Alaska	36,000	45,000	74,800	
Total	1,106,400	985,300	872,900	653,000

* The reports from other rivers in California have not yet been obtained.
† The 1886 statistics are incomplete.
‡ The estimated pack on the Sacramento previous to 1883 was: 1878, 36,500; 1879, 31,000; 1880, 51,000; 1881, 181,200; 1882, 200,300.
§ Exclusive of the Fraser River pack.

TABLE II.—*Salmon canneries on the Sacramento River.*

Name of cannery.	Location.	Brand.	Agents in San Francisco.
Benicia Packing Company	Benicia	Sac. River salmon	George W. Hume.
Carquinez Packing Company	do	Spread Eagle	Do.
Booth & Co., S.	Black Diamond	Seal	Scotchler & Gibbs.
Joseph Hume	do	Pioneer	Joseph Hume.
Bradford & Company	Chipp's Island	Crescent	W. B. Bradford.
Sacramento River Packing Co	do	Star of Columbia	Do.
Courtland Packing Company	Courtland		William T. Coleman & Co.
Joseph Black	Martinez	Spring Sac. fish	Cutting and Packing Company.
Capitol Packing Company	Sacramento	Capitol	D. L. Beck & Sons.

Vol. VI, No. 19. Washington, D. C. Nov. 18, 1886.

88.—REPORT ON THE SHAD WORK OF THE STEAMER FISH HAWK DURING THE SEASON OF 1886.*

By Mate JAMES A. SMITH, U. S. N.

[Abstract.]

The shad work prosecuted by the U. S. Fish Commission steamer Fish Hawk during the season of 1886 covers the period from April 25 to June 3, inclusive. Most of the operations were conducted on the Delaware River, though some of the work in the first part of the season was done on the northern end of Chesapeake Bay.

On April 24 the Fish Hawk arrived at Battery Station from Wood's Holl, Mass., and on the 25th preparations for the season's work were begun. On the 26th the vessel proceeded across to the east side of the bay and took up a position in the mouth of North East River, from which the spawn-takers could conveniently visit the fishing-shores and the gillers in the vicinity, and arrangements were made for paying the fishermen for the ripe shad furnished. This work was continued until May 1, when orders were received to proceed to the Delaware River. Up to this time 2,192,500 eggs had been taken, which, on May 2, were transferred to Battery Station, and on the 3d the vessel proceeded down Chesapeake Bay bound for the Delaware.

On May 5 arrived in the Delaware River, and at 1 p. m. anchored off Gloucester City, N. J. This point was the headquarters for most of the subsequent operations on the river, as from it most of the gillers and fisheries could easily be reached by the spawn-takers. Found the U. S. Fish Commission steamer Lookout at anchor at this place, and on the 6th received from her 1,156,000 eggs. The Lookout was of assistance also by towing the spawn-boats to and from some of the various fishing-shores, and by transporting the spawn-takers. On May 6 the Fish Hawk steamed down the river, stopping at the different shores, where the proprietors were seen and arrangements made about paying them for shad spawn taken. At 10.30 p. m. of the 7th the vessel grounded on the mud-flats off the mouth of Mantua Creek, where she remained till 4 a. m. of the 8th.

On May 11 transferred to Dr. E. G. Shortlidge, of the Delaware fish commission, 660,000 eggs; while in the channel off Gloucester, deposited 1,140,000 fry from eggs obtained on the river. On the 12th went down the river to Wilmington, Del., where arrangements were made to

* This report was compiled from the records of Lieut. L. W. Piepmeyer, U. S. N., who was in charge of the vessel when the work was done.

repair steam-launch No. 55, just arrived from Battery Station. Sent to Dr. Shortlidge* 450,000 more eggs, after which returned to the usual anchorage off Gloucester. On the 13th launch No. 55 arrived from Wilmington and began to render service in distributing spawn-takers and tending the different fishing-shores. The fishermen reported a great decrease in the catch of shad for the week ending May 15, and attributed this to the constant easterly weather. Almost daily deposits of fry were made in the river, as will be seen from the appended table.

Owing to heavy rains the river was very muddy during the middle part of May, and some of the eggs in the jars and cones were covered with a muddy sediment and died. This led to the use of raw cotton in the jars for the purpose of filtering the water.

On May 27 William P. Sauerhoff reported for duty from Battery Station, to assist in shad-hatching work. On the 31st orders were received to discontinue gathering spawn.

On June 3 transferred to Dr. E. G. Shortlidge 180,000 fry; a shipment was also made to Philadelphia, in launch No. 55, of fifteen cans containing 1,940,000 fry, which were delivered to U. S. Fish Commission car No. 2. As there were no more eggs or fry on hand, this terminated the shad-hatching operations of the Fish Hawk for the season of 1886. Appended will be found a table giving details of the work, showing especially the number of eggs taken, the number of fish hatched, the number deposited, and the times and places of deposit, with other statements of particulars in this connection.

U. S. FISH COMMISSION STEAMER FISH HAWK,
Wood's Holl, Mass., October 11, 1886.

---

* Dr. Shortlidge reported that the general condition of the 1,110,000 eggs which he received from the Fish Hawk on May 11 and 12 was bad, as at least one-third were found dead on unpacking. The subsequent loss on these eggs was about one-eighth. All the fry were planted in the Brandywine Creek, near Wilmington. July 21 a small shad was caught in Brandywine Creek, supposed to have been one of those planted in May.

Record of shad operations by the Fish Hawk on the Susquehanna and Delaware Rivers, during the season of 1886.

Date.	Fishery.	Number of— Males.	Females.	Eggs taken.	Time put in cones.	Time began hatching.	Number hatched.	Number deposited.	Time deposited.	State of water.	Temperature of surface. Max.	Min.	Temperature in cones. Max.	Min.
1886.											°	°	°	°
Apr. 26	Red Bank	1	1	30,000	9.15 p. m			(*)		Clear	67	65	64	61
27	....do	1	1	30,000	9.15 p. m					....do	65	65	65	63
28	Gillers	5	8	150,000	1.50 a. m					....do	66	65	65	64
28	....do	9	6	180,000	3.00 a. m					....do	65	64	65	64
28	Carpenter's Point	3	3	128,000	8.15 p. m					Partly muddy	63	61	65	64
28	Gillers	4	4	120,000	9.30 p. m					....do	61	60	65	64
29	....do	2	2	72,000	2.00 a. m					....do	62	61	65	64
29	....do	6	6	262,500	8.00 p. m					....do	62	60	63	63
29	....do	7	8	400,000	11.20 p. m					....do	62	60	63	63
29	....do	9	9	330,000	11.30 p. m					....do	62	60	63	63
30	....do	2	3	82,500	10.00 p. m					....do	63	61	63	63
30	....do	3	3	127,500	11.30 p. m					....do	63	61	61	62
May 1	....do	9	9	280,000	4.30 a. m				(†)	....do	61	60	63	63
5	Faunce's	5	5	200,000	11.00 p. m	May 10	160,000	160,000	May 11	Muddy	61	59	61	61
5	Eagle Point	1	1	40,000	11.00 p. m	May 10	35,000	35,000	May 11	....do	61	59	63	61
6	Lookout	10	12	568,000		May 9	465,000	465,000	May 11	....do	62	61	63	61
6	....do	8	10	588,000		May 9	480,000	480,000	May 11	....do	62	61	63	61
6	Faunce's	3	3	195,000	5.30 p. m	May 10	170,000	170,000	May 12	....do	62	61	63	61
6	Howell's Cove	3	3	161,000	6.30 p. m	May 10	140,000	140,000	May 12	....do	62	61	63	61
6	Gloucester Point	4	4	262,500	8.00 p. m	May 10	220,000	220,000	May 12	....do	62	61	63	61
6	Howell's Cove	10	10	578,000	9.00 p. m	May 10	470,000	470,000	May 12	....do	62	61	63	61
6	Eagle Point	3	3	157,500	11.00 p. m	May 10	135,000	135,000	May 12	Partly muddy	62	61	63	61
6	Faunce's	6	0	208,000	11.00 p. m	May 10	166,000	166,000	May 14	....do	62	61	63	61
6	Woodbury	7	7	397,500	11.00 p. m	May 10	320,000	320,000	May 14	....do	62	61	63	61
7	Lookout			500,000	7.00 a. m	May 10	400,000	400,000	May 14	....do	62	62	63	62
7	Howell's Cove	2	2	75,000	7.30 p. m	May 11	65,000	65,000	May 15	....do	62	62	63	62
7	Gloucester Point	8	8	583,000	7.30 p. m	May 11	480,000	480,000	May 15	....do	62	62	63	62
7	Woodbury	5	5	240,000	11.00 p. m	May 11	200,000	200,000	May 15	....do	62	62	63	62
7	Eagle Point	1	1	45,000	11.00 p. m	May 11	40,000	40,000	May 15	....do	62	62	63	62
8	Faunce's	9	9	380,000	3.30 p. m	May 12	345,000	345,000	May 17	....do	61	61	61	60
10	Howell's Cove	10	10	630,000	7.00 p. m	May 15	450,000	450,000	May 17	....do	62	61	62	60
10	Faunce's	13	13	548,000	7.30 p. m	May 15	400,000	400,000	May 17	....do	62	61	62	60
10	Bennett's	15	15	855,000	Midnight	May 15	400,000	400,000	May 17	....do	62	61	62	60
10	Woodbury	4	4	255,000	10.00 p. m	May 15	160,000	160,000	May 17	....do	62	61	62	60
10	Howell's Cove	14	14	‡1,042,000	Midnight	May 15	191,000	191,000	May 17	....do	62	61	62	60

* All fry were deposited in the Delaware River, except as otherwise indicated.
† The 2,192,500 eggs taken in the Chesapeake were transferred to Battery Station on May 1.
‡ Delivered 660,000 eggs to Dr. E. G. Shortlidge on May 11.

Record of shad operations by the Fish Hawk on the Susquehanna and Delaware Rivers, during the season of 1886—Continued.

Date.	Fishery.	Number of— Males.	Females.	Eggs taken.	Time put in cones.	Time began hatching.	Number hatched.	Number deposited.	Time deposited.	State of water.	Temperature of surface. Max.	Min.	Temperature in cones. Max.	Min.
1886.											°	°	°	°
May 10	Gloucester Point	4	4	210,000	1.00 a. m.	May 15	170,000	170,000	May 17	Muddy	62	61	62	60
10	Faunce's	12	12	420,000	11.30 p. m.	May 15	335,000	335,000	May 17	...do	62	61	62	60
11	Gloucester Point	1	1	37,000	4.00 p. m.	May 15	20,000	20,000	May 17	...do	61	59	60	59
11	Howell's Cove	20	20	1,298,000	10.30 p. m.	May 16	1,046,000	1,046,000	May 17	...do	61	59	60	59
11	Faunce's	12	12	457,500	11.00 p. m.	May 16	367,000	367,000	May 18	...do	61	59	60	59
12	Woodbury	3	3	150,000	7.00 a. m.	May 17	120,000	120,000	May 18	...do	59	59	60	59
12	Bennett's	22	22	*884,000	7.00 a. m.					...do	59	59	60	59
12	Faunce's	7	7	309,000	7.30 p. m.	May 17	246,000	246,000	May 18	...do	59	59	60	59
12	Howell's Cove	7	7	349,000	7.30 p. m.	May 17	280,000	280,000	May 18	...do	59	59	60	50
12	Gillers	3	3	90,000	7.30 p. m.	May 17	80,000	80,000	May 18	...do	59	59	60	59
13	Faunce's	13	13	510,000	9.00 p. m.	May 18	260,000	260,000	May 20	...do	59	59	59	59
13	Howell's Cove	4	4	220,000	9.30 p. m.	May 18	110,000	110,000	May 20	...do	59	59	59	59
14	Bennett's	7	7	345,000	9.30 p. m.	May 19	315,000	315,000	May 21	...do	59	58	59	58
14	Woodbury	1	1	40,000	9.30 p. m.	May 19	32,000	32,000	May 22	...do	59	58	59	58
14	Faunce's	6	6	190,000	9.30 p. m.	May 19	190,000	190,000	May 22	...do	59	58	59	58
14	Howell's Cove	6	6	315,000	9.30 p. m.	May 19	283,000	283,000	May 21	...do	59	58	59	58
15	Gloucester Point	2	2	120,000	6.00 a. m.	May 20	96,000	96,000	May 22	...do	59	58	59	56
15	Howell's Cove	3	3	165,000	5.00 p. m.	May 20	140,000	140,000	May 24	...do	59	58	59	58
15	Woodbury	1	1	23,000	8.00 p. m.	May 20	19,000	19,000	May 24	...do	59	58	59	58
15	Faunce's	6	6	258,000	8.00 p. m.	May 20	206,000	206,000	May 24	...do	59	58	59	58
17	Gloucester Point	2	2	106,000	5.30 p. m.	(†)					59	58	59	58
17	Howell's Cove	9	9	330,000	7.30 p. m.	May 22	265,000	260,000	May 24	Muddy	59	58	60	59
17	Faunce's	7	7	350,000	7.30 p. m.	May 22	280,000	275,000	May 24	...do	59	58	60	59
17	Woodbury	5	5	155,000	8.00 p. m.	May 22	120,000	118,000	May 24	...do	59	58	60	59
18	Gloucester Point	4	4	242,000	6.30 p. m.	May 22	205,000	200,000	May 24	...do	60	59	60	59
18	Gillers	1	1	60,000	7.00 p. m.	May 22	55,000	55,000	May 24	...do	60	59	61	60
18	Howell's Cove	22	22	1,100,000	8.00 p. m.	May 22	880,000	870,000	May 24	...do	60	59	61	60
18	Faunce's	7	7	375,000	8.30 p. m.	May 22	310,000	300,000	May 24	...do	60	59	61	60
18	Woodbury	1	1	46,000	8.30 p. m.	May 22	38,000	37,000	May 24	...do	60	59	61	60
19	Gloucester Point	6	6	246,000	8.30 p. m.	May 23	208,000	205,000	May 25	...do	64	60	61	60
19	Gillers	4	4	164,000	8.30 p. m.	May 23	150,000	150,000	May 25	...do	64	60	60	60
19	Howell's Cove	36	36	1,815,000	8.30 p. m.	May 23	1,455,000	1,450,000	May 25	...do	64	60	60	60
19	Faunce's	8	8	344,000	9.00 p. m.	May 23	290,000	280,000	May 25	...do	64	60	60	60
19	Woodbury	2	2	67,000	8.30 p. m.	May 23	57,000	57,000	May 25	...do	64	60	60	60
20	Gloucester Point	2	2	79,000	8.30 p. m.	May 24	70,000	70,000	May 26	...do	61	60	61	61
20	Gillers	1	1	39,000	8.30 p. m.	May 24	36,000	36,000	May 26	...do	61	60	61	61
20	Howell's Cove	21	21	1,140,000	9.30 p. m.	May 24	1,025,000	1,025,000	May 26	...do	61	60	61	61
20	Faunce's	6	6	300,000	10.00 p. m.	May 24	275,000	275,000	May 26	...do	61	60	61	61

20	Woodbury	3	3	135, 000	10.00 p. m.	May 24	125, 000	125, 000	May 26	....do	61	60	61	61
21	Faunce's	4	4	240, 000	7.00 p. m.	May 24	225, 000	225, 000	May 26	....do	62	60	62	60
21	Gloucester Point	5	5	262, 000	8.30 p. m.	May 24	245, 000	245, 000	May 26	....do	62	60	62	60
21	Howell's Cove	28	28	1, 350, 000	10 30 p. m.	May 24	830, 000	830, 000	May 26	....do	62	60	62	60
22	Gloucester Point	1	1	30, 000	9.00 a. m.	May 25	25, 000	25, 000	May 27	....do	64	64	66	64
22	Faunce's	2	2	70, 000	4.00 p. m.	May 25	60, 000	60, 000	May 27	....do	64	64	66	64
22	Howell's Cove	5	5	390, 000	5.00 p. m.	May 25	215, 000	214, 000	May 27	....do	64	64	66	64
22	Gloucester Point	2	2	95, 000	8.00 p. m.	May 25	85, 000	85, 000	May 27	....do	64	64	66	64
24	......do	1	1	35, 000	9.00 a. m.	(‡)	....	....	....	....	68	67	68	66
24	Howell's Cove	38	38	1, 637, 000	9.30 p. m.	May 27	1, 050, 000				68	67	68	66
24	Faunce's	23	23	1, 024, 000	9.30 p. m.	May 27	625, 000	1, 814, 000	May 30	....do	68	67	68	66
24	Gloucester Point	7	7	376, 000	10.30 p. m.	May 27	169, 000				68	67	68	66
25	Faunce's	20	20	632, 000	9.30 p. m.	May 29	428, 000				66	65	66	65
25	Howell's Cove	22	22	1, 110, 000	10.00 p. m.	May 29	742, 000	1, 495, 000	June 2	....do	66	65	66	65
26	......do	9	9	465, 000	8.00 p. m.	May 30	325, 000				64	64	65	64
27	Faunce's	6	6	301, 000	7.30 p. m.	May 30	252, 000				65	65	65	65
27	Howell's Cove	29	29	1, 111, 000	7.30 p. m.	May 30	918, 000				65	65	65	65
28	Faunce's	5	5	176, 000	7.00 p. m.	May 31	160, 000				65	65	65	65
28	Howell's Cove	16	16	718, 000	8.30 p. m.	May 31	610, 000	(§)	....	....	65	65	65	65
29	......do	4	4	133, 000	4.30 p. m.	May 31	90, 000				65	65	65	65
29	Bennett's	4	4	115, 000	5.30 p. m.	May 31	90, 000				65	65	65	65
	Total	720	726	34, 454, 500	....	....	23, 196, 000	21, 018, 000						

* Four hundred and thirty-four thousand died, and 450,000 eggs were delivered to Dr. Shortlidge on May 12.
† All died.
‡ Lost overboard.
§ On June 3, 1,940,000 fry were shipped to U. S. Fish Commission car No. 2, and 180,000 fry were sent to Dr. Shortlidge.

89.—CATCH OF SHAD IN THE HUDSON RIVER FOR 1885.

By E. G. BLACKFORD.

The statistics of the catch of shad in the Upper Hudson, which extends from Albany to Highland Falls (some 2 miles below West Point), were compiled by Mr. Matthew Kennedy, of Hudson, N. Y., and those for the Lower Hudson, which extends from Peekskill to New York Bay, were collected by Mr. Joseph H. Godwin, jr., of Kingsbridge, N. Y. The above gentlemen took account of all shad caught in the Hudson and sent to other than New York markets. In New York City Mr. W. H. Faulhaber obtained statistics of all shad on the west side of the city, while the figures for the east side, comprising Fulton Market and vicinity, were gathered by Mr. L. T. Herrmann. A summary of these statistics is as follows:

Sold in the New York markets	796,312
Additional catch in the Upper Hudson	276,273
Additional catch in the Lower Hudson	102,250
Total	1,174,835

The average price of the catch for the season was $15 per hundred, making the total value of the catch at wholesale prices $176,225.25.

From information received from fishermen and shippers it seems that the catch in the upper portion of the river shows a decrease of about 40 per cent as compared with the previous five years, and between Albany and Barrytown the catch this year as compared with that of five years ago is one-half less, and with ten years shows a decrease of about two-thirds. Less fishing is done on this account, some grounds being entirely abandoned, and others but partially fished. South of Barrytown, however, there is an increase in the number of nets and fishermen, which makes it all the more difficult for the shad to reach their natural spawning grounds.

The fishermen report the season also a poor one in the lower part of the river, the principal reason given being the cold weather during the early part of the season, when the best catches are usually made. During the early run of the fish, moreover, the nets were more or less choked up with a weed or grass (called "oakum") from the bottom, which occasioned great inconvenience and prevented the taking of many fish. More shad were taken by drift-nets and fykes in shallow water and on the flats than for several years before. This is perhaps due to the fish leaving the cold deep water and seeking for warmth in the shallow waters.

BROOKLYN, N. Y., *August* 13, 1885.

90.—REPORT ON THE SHAD WORK OF THE STEAMER LOOKOUT DURING THE SEASON OF 1886.

By Mate JAMES A. SMITH, U. S. N., Commanding.

[Abstract.]

The work in gathering, transferring, and hatching the spawn and depositing the fry of shad, performed by the U. S. Fish Commission steamer Lookout during the season of 1886, covered the time from April 27 to May 23, inclusive. The greater part of the eggs obtained came from the Delaware River, but about one-third were gathered at the northern end of Chesapeake Bay and its inflowing streams. Most of the eggs were transferred to Battery Station or to the Fish Hawk, while some were hatched on board and deposited from the Lookout. During the season 3,000,000 fry were received from Battery Station and deposited in the tributaries of the Upper Chesapeake.

The season's work began on April 27 in the mouth of the Susquehanna River, where the floats and gill-boats were visited, but no ripe spawn was obtained. On the 29th received 500,000 shad fry from Battery Station and deposited them in the mouth of North East River. From the gill-boats in this vicinity obtained 520,000 eggs, which were transferred the next day to Battery Station. On the 30th left this station, passed through the Chesapeake and Delaware Canal to the Delaware River, communicated with some of the fishing-shores, and late at night anchored off Gloucester City, N. J., a few miles below Philadelphia, which was a convenient point from which to visit many of the most important shad fisheries in the river.

On May 3 went to Wilmington, Del., for the purpose of having some repairs made, but returned to the spawn-taking work on the river during the afternoon. On the 5th the Fish Hawk arrived, and the Lookout received orders to co-operate with her in gathering spawn, in obedience to which, the work was carried on conjointly for several days. On the 8th passed through the canal to Chesapeake Bay, and proceeded to Battery Station.

On May 10 Commissioner S. F. Baird and Assistant Commissioner T. B. Ferguson came on board at Havre de Grace, and were taken to Battery Station. All the eggs obtained during the last few days were transferred to the station, and several deposits were made on that and subsequent days in the Susquehanna, North East, and Sassafras Rivers, of fry received from the station. Many of the fishing-shores and gillers in this region were visited almost daily, but comparatively small numbers of eggs were taken, as the shad were becoming scarce, and these were duly transferred to the station. On the 15th proceeded to Baltimore.

On May 18 left Baltimore and returned to Battery Station, where the gathering and transferring of spawn were resumed. On the 22d some of the fisheries had ceased operations and most of the gillers on the east side of the bay had stopped fishing for the season, so the spawn-takers from the Lookout were sent out to gather spawn in the immediate vicinity of the station and to attend the gillers above the station, which resulted in getting 218,000 eggs on the 22d and 23d.

On May 23, as the fishing season was about ended, orders were received to discontinue the operations by the Lookout.

Appended will be found tables giving records of the shad operations during the season and of meteorological observations made in the vicinity of Havre de Grace and on the Delaware River during a portion of the month of May. The total number of eggs procured by the crew of the vessel was 4,561,000.

TABLE I.—*Record of shad operations conducted near Havre de Grace, Md., and on the Delaware River, on the U. S. Fish Commission steamer Lookout.*

Date.	Ripe fish.		Eggs obtained.	Whence obtained.	Transferred to—		Fish deposited.	
	Males.	Females.			Battery Station.	Fish Hawk.	Number.	Place.
1886. Apr. 29	8	11	520,000	North East River.	520,000	....	*500,000	Mouth of North East River.
30	3	5	185,000	Delaware River...	....	....	....	
May 1	....	....	....	....	....	....	....	
2	....	....	....	....	....	....	....	
3	4	6	222,000	Delaware River...	....	....	....	
4	11	14	904,000	......do	....	....	....	
5	9	11	637,000	......do	....	....	....	
6	7	11	500,000	......do	....	1,156,000	....	
7	12	12	672,000	......do	....	500,000	150,000	Opposite Billingsport, Delaware River.
8	....	....	....	....	....	....	....	
9	....	....	....	....	....	....	50,000	In channel, opposite Battery Sattion.
10	....	....	....	Gillers..........	992,000	....	110,000	In channel, opposite Battery Station.
11	2	2	84,000	North East River.	84,000	....	*1,500,000	North East River, between Carpenter's Point and Red Bank.
12	1	1	25,000	......do	25,000	....	....	
13	4	6	222,000	......do	222,000	....	*1,000,000	Opposite Ordinary Point, Sassafras River.
14	2	3	110,000	......do	110,000	....	....	
15	....	....	....	....	....	....	....	
16	....	....	....	....	....	....	....	
17	....	....	....	....	....	....	....	
18	1	1	49,000	North East River.	49,000	....	....	
19	....	....	....	....	....	....	....	
20	3	4	130,000	North East River.	130,000	....	....	
21	2	3	83,000	......do	83,000	....	....	
22	3	4	103,000	......do	103,000	....	....	
23	4	5	115,000	......do	115,000	....	....	
Total.	76	99	4,561,000	....	2,433,000	1,656,000	3,310,000	

* Received from Battery Station.

TABLE II.—*Record of temperature observations made at Havre de Grace, Md., and on the Delaware River, on the U. S. Fish Commission steamer Lookout, from May 1 to May 10, 1886.*

Date.	Temperature of air.			Temperature of surface water.			Temperature of bottom.			Condition of sky.		
	8 a. m.	4 p. m.	12 midnight.	8 a. m.	4 p. m.	12 midnight.	8 a. m.	4 p. m.	12 midnight.	8 a. m.	4 p. m.	12 midnight.
1886.	°	°	°	°	°	°	°	°	°			
May 1*	50	56	52	58	60	56	58	58	58	Overcast	Overcast	Overc'st.
2	55	72	53	57	61	59	53	60	59	Clear ...	Clear ...	Clear.
3	70	80	54	62	62	59	......	60	59	...do ...	Partly Cloudy	Do.
4	66	75	64	60	62	61	60	60	61	...do	Cloudy.	Cloudy.
5	66	78	62	61	62	62	60	62	62	...do	...do	Overc'st.
6	70	80	58	61	64	61	61	63	61	Cloudy .	...do	Clear.
7	67	60	64	62	63	61	61	63	61	Clear ...	Rain....	Rain.
8	64	59	58	61	63	59	61	63	59	Cloudy .	Cloudy .	Cloudy.
9	60	75	70	58	63	61	58	63	60	Clear ...	Clear ...	Do.
10	65	78	....	60	62	....	60	62	....	Cloudy .	...do	

Date.	Wind, direction.			Wind, intensity.			State of tide.		
	8 a.m.	4 p.m.	12 midnight.	8 a.m.	4 p.m.	12 midnight.	8 a.m.	4 p.m.	12 midnight.
1886.									
May 1*	NE.	NE.	NE.	9	8	9	Flood	Ebb	Flood.
2	NE.	NE.	NE.	8	5	4	Ebb........	...do	Do.
3	Calm.	SW.	SW.	0	1	2	...do........	...do	Do.
4	SW.	SSW.	S.	1	3	2	...do........	...do	Do.
5	SW.	SW.	SE.	4	7	3	...do........	...do	Do.
6	NE.	NW.	S.	1	1	1	...do........	...do	Do.
7	E.	NE.	NE.	3	3	10	...do........	Flood......	Do.
8	NE.	NE.	NW.	4	10	3	...do........	Ebb	Do.
9	NW.	Calm.	Calm.	3	0	0	...do........	...do	Do.
10	SE.	Calm.	....	2	0	....	...do........	...do	

* The bottom thermometer in use was No. 5264.

91.—CATCH OF SHAD IN CONNECTICUT FOR 1886.

By ROBERT B. CHALKER.

The statistics of the catch of shad for the year 1886 in the State of Connecticut are as follows:

POUND FISHERIES.

From the mouth of the Connecticut River to New Haven Harbor:

15 traps in Saybrook	23,200	
22 traps in Westbrook	34,300	
11 traps in Clinton	12,400	
10 traps in Madison	5,100	
7 traps in Guilford	1,100	
7 traps in Branford	3,300	
3 traps in East Haven	800	
Total shore fisheries		80,200

RIVER FISHERIES.

Thames River		45
Connecticut River and tributaries:		
Hauling-seines	12,000	
Gill-nets:		
33 from Saybrook Bar to Essex Reach	21,500	
5 at Essex Reach	2,500	
5 at Brockway's Reach	2,700	
12 at Chester Reach	7,800	
		46,500
Quinepiac River, 7 hauling-seines		3,000
Housatonic River:		
12 hauling-seines	16,800	
52 gill-nets	8,000	
		24,800
Total river fisheries		74,345
Total catch of shad in the State		154,545

The fishermen have no theory regarding the remarkable decrease in the catch of shad this year,* as the weather and the condition of the water were what have always been considered favorable. The shad did not appear upon the coast in schools as usual, but the daily catch was very uniform, and the fish were large and good; those weighing 7 pounds were frequently taken. It is a remarkable fact that no alewives were seen in the Thames either before or during the season. The first shad was caught in the Connecticut River, at Essex Reach, on April 2; the next was caught in a gill-net, weight 5 pounds; and the first caught by the shore fishermen was in a pound 8 miles west of the mouth of the river, on April 16. There were none caught in the pounds directly at the mouth of the Connecticut till April 24. The contract price for the season was 15 cents per shad, delivered at the packing places. The average price of those sold by commission dealers was 25 cents.

As heretofore, the river fishermen speak of the dead shad and other fish seen floating on the water. It is their opinion that it is caused by the pollution of the streams.

SAYBROOK, CONN., *August* 20, 1886.

---

* An editorial in the Hartford Times of June 22, 1886, says: The reasons given for the decrease are many and varied; but upon one fact all fishermen agree, that since the building of the new jetties at Saybrook Point, very few shad have entered the Connecticut River.

The Connecticut fish commissioners in their annual report for 1886 say: "It is difficult to account for these facts on any other theory than that the number of shad is gradually decreasing in consequence of the increased demand for them and the constantly improving methods of capturing them. In other words, it is simply a question whether the natural propagation of the shad, combined with the operations of the commissioners along the coast in artificial hatching, shall prove sufficient to supply the demand of a constantly increasing population."

92.—NOTES ON THE RED-SNAPPER FISHERY.

By J. W. COLLINS.

The following notes relative to the past and present of the red-snapper fishery on the coast of Florida are based on information gathered from Capt. Silas B. Latham, of Noank, Conn., who was one of the pioneers in this industry, and who still engages in it during the winter season.

Fishing for red snappers on the west coast of Florida probably began some fifteen to twenty years previous to the civil war. Capt. James Keeny, a Connecticut fishermen, who used to go to the Gulf each winter in the smack Mississippi, beginning these trips nearly thirty years before the war, often told the following story of the beginning of the red-snapper fishery:

"On one occasion when I was on my way to New Orleans with a cargo of beach fish (pompano, sheepshead, red-fish, &c.), I got becalmed when several miles off shore. We had just finished eating, and the cook came on deck and threw over some refuse from the table. The vessel lay motionless, and very soon many strange looking red fish were seen in the water alongside, eagerly feeding on the material the cook had thrown overboard. We quickly baited some lines and threw them out, and the fish bit as fast as we could haul them in. Nearly two hundred snappers were caught, which we took to New Orleans, where they sold like hot cakes."

The fishermen knew nothing of the off-shore grounds of the Gulf at that time, according to Captain Latham, who says that Captain Keeny and his crew did not even know that they were on soundings—that is, in less than 100 fathoms, where they caught the first red snappers. This lack of knowledge of the soundings in the Gulf delayed the discovery of the red-snapper banks, even after this accidental capture by Captain Keeny. But when they were ultimately found, the snapper met with a fair demand in the Southern markets.

At the start all fish of this species were taken only on welled vessels. If the smacks ran to New Orleans, the snappers were kept alive until the vessels entered the Mississippi. A few hours later, with the assistance of a tug, they would arrive at the city.

Captain Latham says that he was the first to use ice in the Gulf fishery for the purpose of preserving fresh fish on board a vessel. In the spring of 1868 he purchased 8 tons of ice to use on beach fish caught at Tampa Bay. He paid $25 per ton for the ice. He iced his cargo of fish, including a considerable number of red snappers which he caught on his way from Tampa to Mobile. For this innovation, he was called the "crazy Yankee."

For several years past, Captain Latham has fished on the east side of Florida, landing his catch chiefly at Savannah for shipment to New

York. He generally fishes for red snappers from off Cape Canaveral southwardly to Indian River, in 12 to 15 fathoms of water. Comparatively few snappers are caught north of Cape Canaveral, the grounds north of the cape being of little value in winter except for the capture of blackfish and various other species, most of which are not commercially valuable.

The fishing-grounds on the Atlantic side differ materially from those on the west side of Florida. While the favorite localities for red-snapper fishing in the Gulf are generally depressions of the sea bottom, commonly called "gullies" by the fishermen, on the east coast the snapper is found most abundant on narrow coral ridges, which usually run parallel with the coast line, and are elevated 2 or 3 feet above the bottom immediately surrounding them. Some of these ridges are not more than 100 feet wide, while others may be 300 feet wide or more.

The methods of fishing differ somewhat from those commonly employed in the Gulf. On the Atlantic side it is seldom that a vessel anchors, the common practice being to fish "at a drift." Occasionally a "bunch of fish" is struck late in the day, and then it is usually the best plan to anchor and hold on until next morning, when fishing can be resumed, for it seldom happens that red snappers bite so well at night as they do by daylight.

Red snappers are not nearly so abundant on the east coast as they are on the west coast of Florida, but they average larger in size. A vessel carrying a crew of seven men will make a trip in about two weeks, and an average fare will be about 6,000 pounds.

The Connecticut vessels fishing on the east coast generally carry from home several barrels of salt menhaden for a reserve supply of bait. The greater part of the bait, however, is obtained on the fishing-grounds, refuse fish being used for this purpose, among which sharks are highly esteemed. Sometimes bait is obtained from the fish-traps along the coast.

The food of the snapper is various. Captain Latham says he has often caught snappers off the Saint John's River, Florida, which, after being taken on deck, disgorged small mackerel of "spike" size, which he thought were of the common species (*Scomber scombrus*).

The New York and Connecticut vessels generally ship their fish through to New York, where their agents dispose of the catch. The price received for the fish is governed by the supply and demand, and is influenced to a lesser extent by the size of the fish, a small red snapper being relatively much more valuable than a large one.

GLOUCESTER, MASS., *November* 10, 1886.

93.—CATCH OF SHAD IN THE DELAWARE RIVER FOR 1885.

By P. F. JANN.

The statistics of the catch of shad in the Delaware River during the season of 1885 are as follows:

Shad catch of 1885.

Caught in gill-nets and sent to Philadelphia	502,786	
Caught in seines and sent to Philadelphia	242,710	
		745,496
Sold at Chester, Marcus Hook, and Wilmington	200,000	
Sold at Penn's Grove, N. J	55,000	
Sold at Pennsville, N. J	15,000	
Sold at Trenton, Beverly, Billingsport, Burlington, &c	75,000	
		345,000
Shipped from Stow Creek to New York City		50,000
Total		1,140,496

Shad were received at Philadelphia from April 9 to June 10. The largest number on any one day was on April 29, when 71,008 shad were brought to the Philadelphia markets. The average price during the season was about $22.50 per hundred. The total catch of 1,140,496 is the largest that has been known on the Delaware for several years.

PHILADELPHIA, PA., *June* 24, 1885.

94.—CATCH OF SHAD IN THE DELAWARE RIVER FOR 1886.

By P. F. JANN.

The statistics of the catch of shad in the Delaware River during the season of 1886 are as follows:

Shad catch of 1886.

Caught in gill-nets and sent to Philadelphia	347,494	
Caught in seines and sent to Philadelphia	191,523	
		539,017
Sold at Chester, Pa	120,000	
Sold at Marcus Hook, Pa	50,000	
Sold at Wilmington, Del	70,000	
Sold at Penn's Grove, N. J	30,000	
Sold at Pennsville, N. J	10,000	
Sold at Trenton, Beverly, Billingsport, Burlington, &c.	25,000	
		305,000
Shipped from Stow Creek to New York		30,000
Total		874,017

The catch for the Delaware in 1886 shows a considerable falling off, while the southern catch and that in the Hudson River show an increase. The gains in the different sections depend much upon the weather. Elizabeth City, N. C., and vicinity, had an exceedingly good catch, while considerable amounts were taken in South Carolina and Florida.

PHILADELPHIA, PA., *July* 29, 1886.

95.—DISTRIBUTION OF SHAD FRY DURING 1886.

By M. McDONALD.

The total distribution of shad fry for the season of 1886 amounts to over 90,000,000. As the entire number of shad taken for market is something less than 6,000,000, it will be seen that for every shad taken from the waters this season for market, there have been artificially hatched and returned to the waters fifteen young shad. Assuming that the entire cost of production and distribution has been $20,000 (and it will not exceed this), the young fish have been produced and distributed over the entire United States at a rate of about $215 for a million, or about forty-six fry for a cent.

Another interesting fact to note is that for the entire time up to and including 1882 there were produced 200,000,000 young shad; while for 1886 alone the total was over 90,000,000. This indicates that we are certainly getting to a point where the work may be regarded as profitable from a commercial standpoint.

The following is a summary of the shad distributed during the season of 1886, arranged by river basins:

Tributaries of Narragansett Bay	2,534,000
Tributaries of Long Island Sound	749,000
Hudson River	2,312,000
Delaware River	21,618,000
Tributaries of Chesapeake Bay	52,560,000
Tributaries of Albemarle Sound	1,990,000
Streams draining into the Atlantic south of Albemarle Sound	4,183,000
Mississippi River and minor tributaries of Gulf of Mexico	4,758,000
Colorado River, Gulf of California	850,000
Columbia River Basin	850,000
Total	92,404,000

WASHINGTON, D. C., *July* 21, 1886.

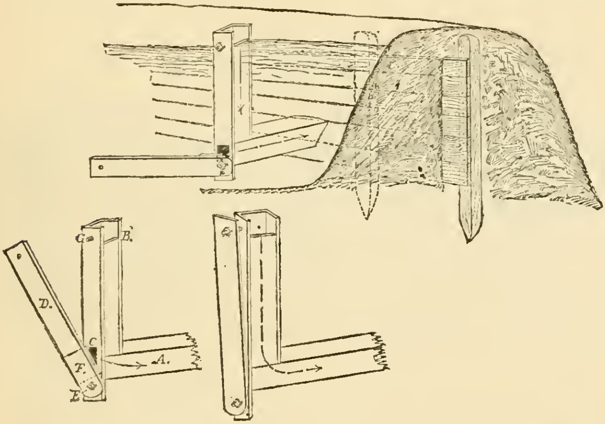
96.—DESCRIPTION OF CARP PONDS AND WATER GATE.

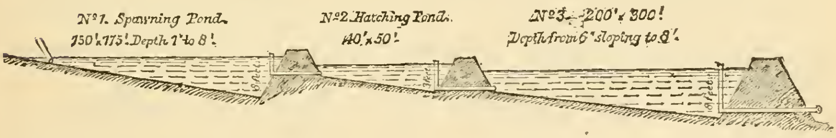
By JULIUS GROSS.

Carp Ponds.—Pond No. 1 is a spawning pond, 150 by 175 feet. This slopes from 1 inch to 8 feet in depth, and is supplied with spring water, which is brought about 1,200 feet in tile pipes.

Pond No. 2 is a little hatching pond, 40 by 50 feet, which slopes from 1 inch to 3 feet in depth, and receives its water from No. 1, while its outflow empties into No. 3.

Pond No. 3 is a raising or stock pond, 200 by 300 feet, sloping from 6 inches to 8 feet, and supplied with water from a creek.





I have found that the best way of transferring the eggs from No. 1 to No. 2 is by putting live cedar brush into the spawning pond, and after the eggs are deposited they can easily be removed to the hatching pond.

When the ponds are to be drained, all three empty into a creek which flows near by, and is several feet lower than the ponds. When No. 1 is drained to take out the young fish, the old ones are put into No. 2, where they remain until all necessary repairs have been made. No. 1 is then filled to half its depth with back-water from No. 3, a fine strainer being kept in the inflow to prevent intruders from coming in with the back-water, while the spring fills the remainder of the pond. The spawning fish are then replaced in No. 1.

Water Gate.—At the outflow of a carp pond there is apt to be some trouble, caused by leakage or by muskrats or crawfish making holes in the

dike. This may usually be avoided by constructing the outflow in the following way: In the middle of the dike, where the outflow goes through, a partition wall should be built of good oak plank, as shown in the sketch.

A is a box of 2-inch oak plank, about 8 or 10 inches square, and long enough to pass underneath the dike. B is the overflow.

C is the opening for draining the pond, while D is a board acting as a lever to open and close C. This lever must work very easily.

E is a screw-bolt fastened below.

F is a little board $\frac{3}{4}$-inch thick, sufficient to cover the opening C.

G is another screw-bolt similar to E. When the lever is in perpendicular position, the bolt is put through and the nut screwed on, making the opening C water-tight.

COLUMBIA, ILL., *October* 18, 1886.

97.—AMERICAN FISH IN NEW ZEALAND.*

The authorities of New Zealand have sent to America for the ova of the landlocked salmon, the rainbow or California trout, the whitefish, and a fresh stock of the brook trout. The rainbow trout (*Salmo irideus*) will probably be an exceedingly valuable addition to the salmonoids in the waters of New Zealand, as it endures a high temperature, is not destructive to its own kind, is a splendid food-fish, and affords good sport.

During 1880 and 1881 about 770 of the American brook trout (*Salvelinus fontinalis*) were distributed among three of the rivers of New Zealand. No result has yet been reported from these; but the adult fish in the care of the Acclimatization Society have done remarkably well and produced a large quantity of ova, which, in spite of several mishaps, has resulted in about 2,500 fry being placed in a race. It is intended to keep the most of these fry until they are yearlings, and thus replenish the stock of parent fish.

A number of the American catfish (*Amiurus catus*) were originally imported into Auckland from America in 1879; and they are now abundant in St. John's Lake and other waters. During last year Captain Fairchild brought a few to Dr. Hector, who liberated 30 in Mr. Percy's pond at Petone. They are said to be a harmless fish, of fair edible qualities, growing to a large size in waters unsuitable for *Salmonidæ*, and easy of capture.

Since 1875 nearly 10,000 fry of the California salmon (*Salmo quinnat*) have been distributed to such localities about the islands as seemed most suitable for the acclimatization and growth of this species.

Large shipments of the Atlantic salmon (*Salmo salar*) have been obtained from England, especially from the Tweed; and since the last annual meeting 19,400 fry have been hatched and liberated.

---

* Extracted from the annual report of the Wellington and Wairarapa Acclimatization Society, September, 1886.

Vol. VI, No. 20. Washington, D. C. Nov. 24, 1886.

98.—NOTES UPON FISH AND THE FISHERIES.

[Extracted from the official correspondence and compiled by the editor.]

STATISTICS OF THE SEA FISHERIES OF FRANCE.*—The following tables give a recapitulation for two years of the sea fisheries of France proper and of the French colony of Algeria:

TABLE I.—*Quantity and value of the sea fisheries of France in* 1883 *and* 1884.

Kind.	1883.		1884.		Value in 1884 compared with 1883.	
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Cod ....pounds..	75, 834, 358	$3, 485, 176	80, 510, 764	$2, 643, 332	....	$841, 844
Herring ....do....	81, 248, 705	2, 547, 034	101, 352, 473	1, 720, 844	....	826, 190
Mackerel..........do....	14, 624, 102	706, 325	21, 162, 427	712, 487	$6, 162	....
Sardines ....number..	1, 148, 375, 978	3, 894, 137	411, 819, 005	1, 702, 949	....	2, 191, 188
Anchovies ....pounds..	4, 918, 075	177, 553	11, 460, 503	201, 354	23, 801	....
Other fish ....do....	116, 875, 465	6, 914, 475	115, 456, 692	7, 043, 843	129, 368	....
Oysters ....number..	157, 666, 246	437, 450	119, 277, 795	336, 772	....	100, 678
Mussels..........bushels..	1, 637, 526	513, 058	1, 361, 966	356, 549	....	156, 509
Other shell-fish..........do....	825, 890	219, 622	1, 040, 529	246, 184	26, 562	....
Lobsters, &c..........number..	1, 712, 885	434, 009	1, 927, 229	528, 184	94, 175	....
Shrimps..........pounds..	2, 902, 094	284, 995	3, 466, 623	365, 080	80, 085	....
Marine fertilizers.....cu. feet..	86, 722, 455	1, 080, 962	88, 174, 261	1, 118, 919	37, 957	....
Total	....	20, 694, 796	....	16, 976, 497	....	3, 718, 299

TABLE II.—*Quantity and value of the sea fisheries of Algeria in* 1883 *and* 1884.

Kind.	1883.		1884.		Value in 1884 compared with 1883.	
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Mackerel..........pounds..	790, 411	$42, 009	847, 148	$67, 753	$25, 744	....
Sardines ....number..	131, 623, 227	141, 030	110, 138, 331	134, 508	....	$6, 522
Anchovies..........pounds..	820, 451	42, 491	688, 031	34, 455	....	8, 036
Other fish ....do....	6, 105, 807	329, 317	7, 027, 057	356, 442	27, 125	....
Lobsters, &c ....number..	27, 542	10, 739	34, 510	12, 890	2, 151	....
Allaches ....do....	29, 011, 126	62, 440	30, 639, 640	43, 874	....	18, 566
Other shell-fish ......bushels..	161	199	207	383	184	....
Shrimps..........pounds..	46, 429	4, 053	95, 968	8, 276	4, 223	....
Bonitos ....do....	38, 902	2, 864	232, 136	14, 924	12, 060	....
Tunnies ....do....	7, 716	540	112, 179	7, 724	7, 184	....
Coral..........do....	29, 087	102, 049	11, 823	42, 437	....	59, 612
Mussels..........bushels..	243	753	125	505	....	248
Oysters ....number..	190, 450	560	238, 020	739	179	....
Total	....	739, 044	....	724, 910	....	14, 134

* For an article on this subject, see F. C. Bulletin for 1886, p. 219.

EXPORTS OF FISHERY PRODUCTS FROM NORWAY.—The total value of the exportation of fishery products from Norway, calculated at the wholesale prices paid at the ports of exportation, and hence inclusive of the Norwegian profit, was, from 1866 to 1884, annually about 42,000,000 crowns [$11,256,000]. Norway therefore receives every year about the same sum for fish which Germany pays annually for fish imported from abroad. The lowest sum, 29,000,000 crowns [$7,772,000], realized from the exportation of fish was in 1868, and the largest, 50,000,000 crowns [$13,400,000], was in 1881. From the year 1870 exportation has gradually increased. Of the total value of fish exported, 27,500,000 crowns [$7,370,000], or 65 per cent, were received for the products of the cod fisheries, namely, "klip-fish," "stock-fish," cod-liver oil, roe, fish-flour, guano, &c.; while the products of the herring fisheries (salt and smoked herring and anchovies) represented 32 per cent, or 13,250,000 crowns [$3,551,000]; and other fish 3 per cent, or 1,340,000 crowns [$359,120], as follows: 434,000 crowns [$116,312] for fresh salmon, 501,000 crowns [$134,268] for fresh mackerel, and 405,000 crowns [$108,540] for lobsters. The increase in the exportation of salmon and mackerel has been very considerable since 1876, principally owing to better methods of preserving these fish.

The principal ports of exportation are Bergen ("stock-fish," cod-liver oil, roe, and salt herring), Christiansund ("klip-fish" and fish-guano), Christiansand and Farsund (salmon, mackerel, and lobsters), Bod in Northland and Vadsöe in Finmark (fish-guano).

The following are the principal countries to which Norway exports fish: "Klip-fish" to Spain; "stock-fish" to Italy, Austria, Sweden, and Holland; salt herring to Germany and Sweden; mackerel, salmon, and lobsters to Great Britain; cod-liver oil to Germany and Holland; roe to France; and fish-guano to Great Britain and Germany.

LOBSTERS AND OYSTERS IN NORWAY.—The lobster fisheries are also principally carried on in the Skager Rack and the North Sea. North of Cape Stat very few are caught, and none at all in the Polar Sea. They are caught in fish-pots. From 1879 to 1884 the average annual yield was 1,175,000 lobsters, valued at 401,000 crowns [$107,468]. The greater portion is shipped to England.

The Norwegian oyster fisneries, carried on principally in the Skager Rack, are inconsiderable, and yield annually about 240 hectoliters [679 bushels], valued at 6,900 crowns [$1,849.20].

COD FISHERIES AT SAINT PIERRE.—Reports from the French colony of Saint Pierre and Miquelon show that the cod fishermen there have been very successful in the amount of their catch. Five hundred boats have been engaged by them in transporting their fish; and 13,000 quintals of cod had been taken to Halifax up to September 15. The price was less than $2 per quintal, a figure that is unprecedentedly low. [From the French *Moniteur de la Pisciculture*, &c., 2d year, No. 20. Paris, September 18, 1886.]

THE ROOSEN PROCESS OF PRESERVING FISH.*—In dispatch No. 79 to the State Department, from the United States consulate at Leith (Edinburgh), Scotland, August 10, 1886, Consul Oscar Malmros spoke of obtaining an equipment for preserving fish by the "Roosen" process, which was to be shipped to the Smithsonian Institution, and inclosed an article from the Fish Trades Gazette, of London, July 31, 1886, from which the following extract is made:

The Roosen process is now pretty well known in England, and it is generally accepted as being by far the most successful attempt to keep fish not only fresh, but also sweet, wholesome, and attractive for long periods. The process, it may be added, is not confined to fish, but has been applied with equal success to meat, game, fruit, &c. Experiments have been carried out in Scotland, and public demonstrations of the value of the process made in Edinburgh and Glasgow, where its merits have been recognized by the very highest authorities on the subjects of fishing and the fish trade. Messrs. Dufresne & Lüders, the agents of Mr. August R. Roosen, of Hamburg, the inventor of the process, lately decided that it would be well to make the process better known in London, and accordingly invited a number of representative guests to witness the opening of several casks of fish preserved by the Roosen process, and to taste the same when cooked. There was an excellent response to the invitation, the guests including many famous authorities in science and in medicine, as well as others holding important governmental positions or being connected with commerce, not only in England, but also in the colonies and Indian Empire. Two casks, which had been closed for seventeen days, were opened before this company, and the fish when taken out were found to be perfectly sweet and fresh, bright looking, and as attractive as the day they were caught. On being eaten they were pronounced excellent, and the advantages of the process were highly commended.

It may be as well to give a brief description of the principles of the now famous Roosen process. For many years the value of boracic acid has been recognized as a preservative agent, but it has been left for a German scientist to discover how properly to apply it and rid it of all obnoxious properties or effects. This end is accomplished in the following manner: A strong cask of iron with an adjustable lid is provided, something like the well-known cans used for conveying milk, but considerably larger. In this galvanized-iron barrel are placed a certain proportion of water and a quantity of boracic and tartaric acid. The latter chemical has the effect of removing the slightest taste of the boracic acid, which, by the way, is perfectly harmless and even health-giving. The fresh fish are then placed in the liquid, as many as the cask will conveniently hold. The lid, which is fitted with a large india-rubber ring, so as to make it perfectly air and water tight, is now ad-

* For previous articles on this subject, see Fish Commission Bulletin for 1886, pp. 65 and 109.

justed and secured. A small portable force-pump is next fixed to a hole in the lid, and the water is pumped into the cask, expelling all air, which escapes at another little hole in the lid. As soon as the cask is completely full and the air expelled the water begins to flow through the latter aperture. An air-tight cap is then screwed tightly on this hole to prevent any further escape. Then the pump is once more set to work forcing in water, until a gauge affixed to the pump shows a pressure of 90 pounds to the square inch. By an ingenious contrivance the second hole in the lid is now hermetically closed, and the force-pump removed. The effect of the enormous pressure on the water is to drive the chemical right into the veins and tissues of the fish, and so prevent organic change in any part. So well is this done that the fish will keep for any length of time, and may be sent with perfect safety to any part of the world.

A WAY OF EXTERMINATING FISH IN FINLAND.*—Near the place where the Lappo River flows out of Lake Kuortane its water is compressed between two rocky mountain sides, and forms a little fall. In midsummer when the fish, especially the salmon which were strong enough, have reached a dike which blocks up nearly the entire river, and have gathered near the fall, a dam is constructed in the pass, with a small opening which can be closed with a gate. A little lower and in calmer water an obstruction is placed across the river, also with an opening closed by a large net. The gate in the dike is now closed, the water falls, and with it some of the fish go into the net. The remaining fish are driven into it by pushing and chasing them, or are caught with hand-nets, or killed with all sorts of weapons. When all the water has run out, the net is taken up and the upper gate is opened, whereby a number of fish are enticed to the returning water within the obstruction. The same process is repeated several times within a few days. In consequence the water in the river several miles below begins to fall, and the few salmon which still ascend the river gather in the holes, whence they either are taken alive or are clubbed to death. Men, women, and children engage in this work of destruction. The same scenes are repeated every year during midsummer, just about the time when the bream has deposited its spawn. No one thinks of what is to become of this spawn, which thus for two days lies dry, exposed to the sun and air, nor of all the young fish which are thus destroyed. The fishermen meanwhile very naively express their surprise at the fact that the fisheries have decreased from year to year, so that this year not a single salmon was caught. [From Sporten, Helsingfors, Russia, September 15, 1886.]

SPAWNING OF FISH IN CONFINEMENT.—Sea-trout have been artificially spawned with great success at the South Kensington aquarium, even from fish that had been kept in captivity for three years and had never visited the sea. The different species of the *Salmonidæ* living in

* "*Ocksä ett fiske!*" Translated from the Swedish by HERMAN JACOBSON.

the tank are found to pair quite readily with one another. Fish in captivity yield their ova much later than they do when in a wild state, but of every thirty subjected to artificial existence, only one is, on the average, found to be barren. [From the Popular Science Monthly, New York, November, 1886, p. 143.]

SALMON IN SCOTLAND AND SHIPMENTS TO NEW ZEALAND.—Mr. John Anderson, writing to Prof. S. F. Baird from Denham Green, Edinburgh, Scotland, on July 30 and September 6, 1886, speaks of the taking of salmon eggs in Scotland and of shipments to New Zealand, substantially as follows:

For many years we in Scotland have been taking our salmon ova, as I think, too late. There are five runs of salmon to each river during the year—coming in March, May, July, October, and December—and for forty years all the eggs have been taken in December. Now, it is impossible that ova taken from a salmon in December should ever turn out early fry or salmon. It is not reasonable to look for early fry, if we hatch eggs only from late fish. I have also advised a change of breed from one river to another; and have suggested means for preserving a greater percentage of the spawn and fry than is done under the present natural or even artificial conditions.

I have just heard from New Zealand, that the 29,000 salmon smolts, 9 to 11 inches long, raised from what Mr. Farr took out last year from the river Tweed, were planted in the Southland River in June, 1886, and are doing well. The salmon eggs sent out by Sir James G. Maitland, which were taken from large salmon in December, 1885, were so paralyzed with cold (I suppose) that when the shells broke the fry could not stretch themselves out, but continued in a circular state for some time and then died. It is thought that the cold on the voyage was too severe; while perhaps the eggs were not far enough advanced on being shipped, or were taken from too late fish.

CODFISH ON THE NORTH PACIFIC COAST IN 1886.*—The last of this season's codfish fleet arrived on October 11. This was the schooner Czar, which has made three trips this season, as she also did last year. Though not the first vessel off this year, she was the first to return from the fishing-grounds, because her owners have established a fishing-station at Pirate Cove, at one of the Shumagin Islands. There are small vessels engaged in fishing off the islands all through the season, and the Czar is used simply for transporting the fish from the islands to San Francisco. Lynde & Hough, who have long been in this trade, have also this year established a fishing-station at the islands, the materials for which were sent up by the Arago last January. As a result, one of their vessels, the Dashing Wave, made two trips this season. There were eleven vessels employed in the trade this year, against twelve last year; but there were fourteen cargoes received in each year. The Shumagin Islands are 2,500 miles northwest of San Francisco; the

* For statistics for 1885, see Fish Commission Bulletin for 1886, p. 89.

Behring Sea is about 3,500 miles, and the Okhotsk Sea is about 4,000 miles distant. Some details of the business this year will be found in the annexed table:

Trips of the North Pacific codfish fleet of 1886.

Name of vessel.	Class.	No. of crew.	Destination.	Days on passage.	No. of fish.
Constitution	Barkentine	35	Okhotsk Sea	150	85,000
Fremont	do	35	do	164	140,000
Jane A. Falkenburg	do	35	do	137	100,000
San Luis	do	35	do	151	102,000
Helen W. Almy	Bark	35	Behring Sea	155	170,000
Arago	Schooner	15	Shumagin Islands	256	60,000
Czar (three trips)	do	15	do	155	265,000
Dashing Wave (two trips)	do	16	do	162	108,000
Francis Alice	do	18	Behring Sea	103	69,000
Isabel	do	18	Shumagin Islands	130	92,000
John Hancock	do	16	do	115	41,000
Total		273		1,678	1,232,000

The catch the past season was taken from the following localities:

Shumagin Islands	566,000
Behring Sea	239,000
Okhotsk Sea	427,000
Total	1,232,000

The fourteen cargoes were consigned to the following parties in San Francisco:

	Cargoes.	Number of fish.
Lynde & Hough	6	449,000
McCollam Fishing and Trading Company	4	435,000
N. Bichard	3	256,000
A. Anderson & Co	1	92,000
Total		1,232,000

It is difficult to get at the exact facts and figures in this fishery, but the foregoing may be regarded as an accurate approximation. The average weight of the fish this year was 3 pounds, which makes an aggregate of 1,848 tons for 1886. The number reported is the smallest in five years, there having been a steady falling off in the catch reported for the past four years. [From the San Francisco Bulletin, October 13, 1886.]

CODFISH IN THE GREAT MARKETS OF THE WORLD*.—According to calculations given in the Norwegian statistics of fisheries for 1880, there were annually brought into the markets of the world, during the period from 1872 to 1878, not less than 153,600,000 salt and dried cod-

* "*Klippfisch und Stockfisch auf dem Weltmarkte.*" From reports of the section of the German Fishery Association for the coast and high-sea fisheries, No. 9, Berlin, September, 1886. Translated from the German by HERMAN JACOBSON.

fish, 50 to 75 going to a hundredweight; of this number 124,500,000 were "klip-fish," that is, codfish first salted and then dried; and 28,500,000 were "stock-fish," that is, codfish not salted but simply dried. The latter come exclusively from Norway. The most important countries from which codfish are exported annually are Norway, 63,600,000 (35,100,000 "klip-fish," and 28,500,000 "stock-fish"); Canada, 36,300,000, and Newfoundland, 33,500,000. The remainder is exported from the United States, Iceland, France, Scotland, and Holland. Among the countries which import and consume "klip-fish" and "stock-fish" the Catholic countries of course rank first, Spain taking the lead with 37,900,000 per annum, and the West Indies with 37,700,000; next come Italy and Austria with a total of 18,400,000; Brazil, 12,500,000; Portugal, 8,800,000; and Great Britain and Ireland, 7,100,000. The remaining 31,000,000 are distributed among Sweden, Holland, the United States, South America, Germany, Denmark, Russia, Finland, Belgium, &c. Europe consumes about 60 per cent of the entire quantity, and America 40 per cent. The total annual value of the "klip-fish" and "stock-fish" exported from Norway was, during the period from 1866 to 1884, on an average 19,000,000 crowns [$5,092,000]. Taking the same average price for the "klip-fish" exported from other countries, the average annual value of the "klip-fish" and "stock-fish" brought into the markets of the world, would be upwards of $16,660,000. Although this sum is of course only an approximation, it nevertheless gives a fair idea of the great value to the human race of a single kind of fish, the cod.

AMERICAN CATFISH IN GERMANY.—Max von dem Borne writes from Berneuchen, Germany, on September 23, 1886, stating that on that day he had caught 310 little catfish, which were the young of those sent over by the U. S. Fish Commission in July, 1885.

FISH-CULTURE ON THE FRISCHE-HAFF.—Superintendent of Fisheries Hoffmann, of Pillau, East Prussia, in a communication on the application of fish-culture to the Frische-Haff, printed in the communications of the section for the coast and high-sea fisheries, Berlin, June, 1886, stated that the ponds at Stobbendorf, in which the first experiments with fish along the Frische-Haff were carried on, were stocked in spring with mature bream (*Abramis brama*) of both sexes. These became accustomed to the water by the time they were ready to spawn; and on several warm days deposited their spawn, so that a large quantity of fry could be raised. The young fry were fed with flour, and when sufficiently developed were gradually allowed to pass through the sluice-gates into the Frische-Haff.

The seeming success of this experiment led to other attempts being made, and three ponds were constructed near the little town of Tolkemit and stocked with mature specimens of *Lucioperca sandra* and fry of the *Coregonus lavaretus*. In spite of the greatest care, however, these experiments proved a failure, as nothing more was seen of the young

Coregonus lavaretus, which when placed in the ponds, were in excellent condition, nor were any fry of the *Lucioperca sandra* observed. It is intended to make further experiments with mature bream, and to repeat the attempt with the lavaret (*Coregonus lavaretus*).

TURBOT AND SOLE.—In April, 1880, five soles which had been sent from England reached New York, and were taken charge of by Mr. E. G. Blackford, who deposited them outside of Sandy Hook. In October, 1881, out of a consignment of turbot and soles sent from England three soles and six turbot survived. These were transferred to the ocean in Sheep's Head Bay, opposite the Oriental Hotel, in the presence of Mr. Blackford and others who had been conveyed to the spot by the U. S. revenue steamer U. S. Grant.

In order to ascertain whether any trace of the planting of these fish could be found, the Fish Commission steamer Fish Hawk visited the vicinity of Sandy Hook, October 26, 1886, and Capt. James A. Smith reports under date of November 4 that he made several hauls of the beam-trawl about Coney Island, Rockaway, and Sandy Hook, but did not succeed in capturing any soles. From the refuse and rubbish which came up in the trawl (evidently offal from dumping scows) he was of the opinion that if any soles existed in the region they would naturally seek a cleaner bottom. He therefore made several hauls in the vicinity of Sandy Hook light-ship, but with no better success.

PRESSING KYACKS AND SHORE-WHALING FOR FINBACKS IN MAINE.—At Boothbay, Me., I found two parties engaged in pressing fish locally known as "kyacks," which I think will prove to be alewives, but which I could not identify owing to the lack of fresh specimens when I was there. Last year there were two factories engaged in pressing "kyacks," and about 10,000 barrels were landed, in addition to large quantities caught by the mackerel fishermen and thrown away. This year the "kyacks" appeared on the coast in great numbers about July 20; but a few days later they disappeared, and have not been seen in large quantities since, though for the past few weeks they are being taken in increasing numbers, the schools being more or less mixed with large mackerel. Some idea of the size of the schools may be obtained from the fact that single hauls of 200 barrels have been made. The fish are much fatter than is generally supposed, yielding between 2 and 3 gallons of oil to the barrel; and the scrap is equal if not superior to that from menhaden, analyzing about 11 units of ammonia. The oil is of good color, but it chills in cold weather.

Thus far the "kyacks" have not been sufficiently abundant to warrant the factory men in devoting their attention exclusively to this species; but the business is carried on profitably in connection with the shore-whaling for finbacks, which has become important. Last year five small steamers were engaged in this shore-whaling, the fleet landing part of the whales at Provincetown, Mass., and the remainder at the factories in Maine. About seventy-five whales were captured by

this fleet last year, and the carcasses of some of them were boiled and made into scrap, which sells when dried at $22 a ton, the only objection to it being the large percentage of oil which it contains. That made to date averages about 25 per cent of oil. [Extract from a letter of Mr. R. Edward Earll to Prof. S. F. Baird, dated Gloucester, Mass., September 17, 1886.]

SALMON PACKING ON THE COLUMBIA RIVER IN 1886.*—The salmon industry is on the decline on the Columbia River, the total pack for this season being about 436,000 cases,† against 565,000 in 1885, and 626,000 in 1884. The main cause of this falling off is owing to the greed of the fishermen. In former times the fish were caught the entire length of the river as far as the cascades, but by the wheel system in the rapids, and by the entrance at Astoria being almost completely blocked with nets, traps, and seines, not enough get through to the spawning-grounds to keep up the supply. So persistent are the gill-net fishermen that boats go far out from the mouth of the river, and as a consequence many are lost in the breakers on the treacherous sand-bar, which is a terror to all navigators, even in the calmest weather. Fifty men have been lost this season in this perilous business.

There are four methods of fishing: By the wheels; the traps (called pounds on the New England shores); the seines, which are hauled by horse-power in the middle of the stream at low tide; and the gill-nets, the latter being the most important, both in the number of men employed and in the catch.

At Astoria, Oreg., where the Columbia is 12 miles wide, I boarded a tugboat and explored the harbor and observed the fishing, following the unfortunate fish from the net until safely packed in pound cans and cased ready for the Portland steamer. The number of men engaged in this comparatively new industry is estimated at twelve thousand, about one-third being employed on the river and the balance in the canneries. Of the latter, fully three thousand are Chinamen. The labor societies, it is said, will demand the expulsion of these Chinese next year, which if successful, my informant said, would compel the majority of the packers to close their canneries.

The perfection to which the art of preparing this wholesome food for market has attained is the admiration of all who inspect its workings in detail. In all of the packing houses cleanliness is enforced from the dressing to the last act of filling the cans. Hence no one need fear to eat canned salmon, if packed by a reliable house under the factory label. Not a few packers, however, put up what are called "seconds," which may be a poorer grade of fish called "steel-heads," or fish too long out

* This is taken from the letter of a correspondent to the Journal, dated Trinidad, Colo., August 24, 1886.

† The pack for 1886, as here given, is too small. The figures mentioned for 1884 and 1885 may be regarded as approximately correct, though not strictly so. See Fish Commission Bulletin for 1886, pp. 90, 139, and 286.

of the water. These "seconds" are sold to middlemen at a low price and put upon the market as genuine Columbia River stock, but under the label of some one not a packer. There are thirty-nine canneries on the river, but the number of brands on the market is legion. The packers near the mouth of the river are in the best position to furnish good stock, as owing to their nearness to the fishermen they can receive the fish within a few hours after being caught; yet not a few have been twenty-fours dead before "John Chinaman" ranges them on the dissecting table. There are but two canneries out of the thirty-nine that do in fact pack the fish fresh from the water. [From the Journal and Courier, New Haven, Conn., September 1, 1886.]

Growth of salmon and whitefish.—The English National Fish Culture Association reports that its last year's growth of newly-hatched salmon was 6½ inches, and of whitefish 5 inches. [From the Popular Science Monthly, October, 1886, p. 864.]

Salmon and trout at the McCloud River Station.—Mr. Loren W. Green, writing to Professor Baird from the United States trout ponds at Baird, Cal., on September 13, 1886, says substantially as follows:

Salmon in the McCloud River are now very numerous, being more abundant here probably than at other points in the river, on account of the two runs meeting. There is now a very nice run here, fresh from the ocean. The salmon of the large run which went up the river some time ago are now falling back in an exhausted condition, having deposited their spawn near the headwaters. Many of them are floating back dead and a great many more are in a dying condition. In nearly every case their tails are worn threadbare, their eyes sunk deep in their heads, and their bodies covered with a thick coat of fungus. The fish of the up-going run, which is now here, are fresh, bright, round, and fat; their eyes are bright and rounded out; and they are much above the average in size. The Indians are catching a good many and preparing them for their winter use. One passed here yesterday with four which would weigh 30 pounds each. I have weighed several between 5 and 40 pounds.

Trout in the river seem rather scarce. The majority of those we are catching now are small, while those of much size seem poor. Very few young trout can be seen, except those we planted last spring. Near the places where we planted them they seem abundant, but at most other points only straggling trout are seen. A great many trout are being caught out of the river, and but comparatively few are being planted in their stead.

Hatching and feeding of Rocky Mountain trout.—The following is extracted from a letter of Gordon Land, dated Nathrop, Colo., September 7, 1886:

"I believe that the Rocky Mountain trout (*Salmo virginalis*) of this

State are very desirable fish for the trout breeder, inasmuch as they are summer spawners and grow rapidly, are easily taught to feed, and will readily take food from the bottom as well as in transit. They do not bite each other as much as do the common brook trout (*Salvelinus fontinalis*), and live quite harmoniously together. My experience this year in hatching their eggs was somewhat unusual. I took the spawn on June 21, and in seventeen days the eye-specks were plainly visible; in twenty-five days, or on July 16, they hatched. The temperature of the water varied from 52° Fahr. at night to 62° during the middle of the day. Part of the time the eggs were buried in mud from a freshet that had flooded my hatchery, but I did not lose any on that account. They feed like little pigs. I never used water of so high a temperature before. At my other hatcheries the temperature was 45° and 52°; in either case the eggs did well, but were of course longer in hatching. The best results I ever had in feeding were at Buffalo Springs, in South Park [Park County, Colorado], where I fed them on finely chopped suckers—bones, fins, heads, entrails, and everything. The water was cold, 44° Fahr., but when fed on suckers the trout grew at an astonishing rate; many of them, which I sold in the market at nine months old, averaged 4 and 5 ounces each, dressed. Had I possessed warmer water and such an abundance of fish-food, I believe I could have done still better."

CATFISH AND SHAD IN CALIFORNIA.—Mr. William Utter, writing from Campo Seco, Calaveras County, California, on August 12, 1886, states that there are millions of catfish in the Mokelumne River, and that during the summer he had caught a number of fine shad, some of them weighing as much as 3 pounds apiece.

SPANISH MACKEREL ABUNDANT IN SUMMER AT GALVESTON.—Mr. Henry L. Labatt, writing from Galveston, Tex., on September 29, 1886, says: "We have rare sport here in July and August catching Spanish mackerel with hooks and lines. This fishing from the wharves in our harbor is carried on during midsummer with abundant results."

YOUNG SHAD IN THE HOUSATONIC RIVER, CONNECTICUT.—The fish commissioners of Connecticut, in a letter from New Haven, dated October 11, 1886, spoke of having forwarded to the U. S. Fish Commission 40 young fish taken on October 10, with a hook, from the canal at the dam at Birmingham, on the Housatonic River, and asked whether the young fish were not probably some of the shad planted by the U. S. Fish Commission messenger above the dam on May 21, 1886. Dr. Tarleton H. Bean, replying on October 22, stated that these young fish were all shad.

SHAD IN THE MISSISSIPPI AT MEMPHIS.—Mr. W. W. McDowell, fish commissioner for Tennessee, writing from Memphis, Tenn., September 15, 1886, says: "Last April we caught a good many shad in the Mississippi River, near the mouth of Wolf River, about a mile above

Memphis, the daily catch continuing for a little over a week. This is encouraging, as shad were never caught here before."

In a letter dated November 16, 1886, Mr. McDowell adds: "A fish-dealer informs me that his book shows that he bought shad caught here from the 15th to the 28th of March last, his purchases amounting to about 75. From what I can learn, the catch did not at any time exceed 100 per day. The persons that caught them were not fishing for shad, nor were they in the best places for such a catch, but they were after larger fish and the catch of shad was merely incidental. There is no doubt but that the fish in question were actually shad, as the men who bought them have dealt in the Atlantic coast shad for many years. Hence, it is evident that these fish are the results of plants made by the U. S. Fish Commission in the tributaries of the Mississippi."

EDIBLE QUALITIES OF CARP.—The annual dinner of the American Carp Culture Association, whose headquarters is at 44 North Fourth street, Philadelphia, was held October 14. Concerning it the secretary states: "The caterer carried out our instructions to the letter, and the result was that a select party of acknowledged epicures not only tasted but ate several pounds of carp without condiments or seasoning of any description whatever. The verdict seemed to be unanimous that carp raised and treated according to the system prevailing in this region is a first-class food-fish, excelled only by the *Salmonidæ* and superior to the domestic trout.

"After some years of experience we now know that the flavor of the carp depends upon the quality of the water they are in and the quality of food they consume for two or three weeks prior to being served at the table, and also upon the method of their death. If they are taken directly from a muddy pond and allowed to smother and die a lingering death, the flavor will certainly be a 'trifle strong.' If, on the other hand, they are taken from their ponds two or three weeks before coming to the table, and placed in clean water which undergoes constant change, and are fed on clean, cooked vegetable food, almost any grain, or on bread, their flavor will be second only to the salmon family, certainly fully equal to the far-famed shad; but they should be killed by thorough bleeding immediately upon being taken from the water."

CARP IN JAMES RIVER.—Mr. W. F. Page, writing from Lynchburgh, Va., on August 20, 1886, says: "I have seen several very fine German carp taken from the James River at this place, one of which was a female scale carp 25 inches long and weighing 8 pounds."

CARP PLANTED IN PASSAIC RIVER.—Mr. George Shepard Page met the Fish Commission car at Newark, N. J., November 10, 1886, and received 500 carp, which he took to Stanley, N. J., and deposited in the Passaic about midnight. The fish were all in good condition.

GROWTH OF CARP.—The leather carp referred to me, and said to be six months old, was raised in the Government carp ponds at Washington, D. C. It is 9 inches long, 2½ inches deep, 6½ inches in circumfer-

ence, and weighs $5\frac{3}{4}$ ounces. It has been delivered to a curator of the National Museum for preservation in alcohol. [A. Howard Clark, Washington, D. C., October 28, 1885.]

GAME QUALITIES OF CARP.—Mr. A. Shinkle, president of the First National Bank of Covington, Ky., writes concerning the game qualities of carp, that as to the sport of catching them he has never seen their equal, as they exceed the black bass in strength, and that after hooking one he has been as much as fifteen minutes in getting it safely landed.

HOW TO CATCH CARP.—Make a thick mush of corn-meal, in which plenty of salt should be placed; cook it well; tie it up in pieces of cheese-cloth from $1\frac{1}{2}$ to 2 inches square, and pass a hook through the cloth, being careful that it does not appear on the opposite side of the ball of mush. A small wire should be stretched along the dam or along the deepest and straightest edge of the pond, and hooks suspended on cords $2\frac{1}{2}$ feet long, about 4 feet apart. The hooks should just touch the side of the dam or bank which is most frequented by carp in search of food. The bait being on the ground, carp can find and take hold of it better. I use the bass-hook for this purpose, and have caught several that weighed from $2\frac{1}{2}$ to 3 pounds. Care should be taken in handling the fish, for, being very tender, their mouths may be torn. [E. B. Brouster, Clayton, Missouri.]

THE USE OF FISH REFUSE AS MANURE.*—If for some reason one cannot find any other use for dead fish, or for the refuse of fish, this material may profitably be gathered for manure. It should be remembered that as we get only about 3 pounds of dried fish from 13 pounds of fat cod, so the heap of refuse will shrink very much when transformed into manure. This is caused by the quantity of water (about 80 per cent) contained in the flesh and body of the fish. Everybody knows how a fish looks which is exposed to wind and sun and dries in the open air.

Fishermen who have a small piece of ground to cultivate, even if it is only a garden patch, are recommended to gather the refuse from the fisheries and place it in a hole in the ground. They thereby secure a valuable fertilizer, which, used judiciously, will amply repay them for their trouble. The hole should be dry at the bottom, and about 6 feet deep, long, and broad. If the soil is sandy, it will be best to spread some clay at the bottom. On this there should be placed a layer of ashes about 10 inches thick; on the ashes spread a layer of fish for another 10 inches or so, the fish being sprinkled with fine lime. Then follows another layer of ashes, another of fish and lime, and so on until the hole is full. It should be covered with sod, the grassy side downward, and finally the whole spread over with boards, on which some heavy stones may be placed. After six months the hole will contain excellent manure, which may be used or even sold.

---

* Translated from the *Norsk Fiskeritidende*, October, 1886, by HERMAN JACOBSON.

VEGETABLE PARASITES ON CODFISH AND SALT PORK.—Prof. William G. Farlow, writing from Cambridge, Mass., November 28, 1886, says:

"There has appeared on salt pork in this region a bright red growth and a mold. The latter is the same as the *Torula morrhuæ*, described by me on codfish from Gloucester.* The red form, as far as I can yet tell, does not appear to be the *Clathrocystis* found on cod, but is perhaps a form of *Bacterium* or *Bacillus* previously seen on salt pork in France and referred doubtfully to the *Clathrocystis*. It is interesting to know that we have both the forms on codfish and on salt pork."

SALTING AND DRYING THE TONGUES OF CODFISH IN NORWAY.†—The tongues to be used must be quite fresh, as tongues of fish which have been lying even for a day have dark red spots, and make an inferior article which is not worth the trouble and expense of preparing. It is therefore best to use tongues of fish caught with lines, which should be cut out as soon as the fish are brought into the boat, or at any rate as soon as they are landed. Tongues of fish caught in nets are not so good for this purpose, and those of fish which have lain for some time cannot be used at all.

As soon as the tongue is cut out, with the round piece of gristle attached to the root of the tongue, but without any of the portions on the other sides, it is well washed in sea-water, which seems to give to it a more transparent appearance than if it is washed in brine. When the water has run off, the tongues are strongly salted in tight kegs with fine salt (Cadiz or Liverpool salt). When salted they can stand for several months without spoiling. The brine should, however, be examined from time to time. As soon as there is the slightest indication of its being sour, it must be drawn off, and the tongues, after having been well washed in strong brine, must be salted over.

When the drying is to begin, the tongues are well washed in sea-water and immediately piled up in little heaps, so that the water can run off. They should not be allowed to lie in water for any length of time, as is done with klip-fish, but they are taken direct from the keg, washed off, and piled up. When the water has run off, they are laid out to dry, either loose on rocks or, better still, in boxes. After they have dried for a day they will generally be dry on the outside, on which a salt crust forms. When they are taken in at evening, each tongue is well stretched, smoothed down with the hand, and carefully laid in boxes, where they are exposed to a strong pressure. Thus they may stand for two days, or, if the weather is unfavorable, for several days. On the first windy and sunny day they are laid out, turned once during the day, and when they are taken in at night they are again pressed as before. Thus the drying process is continued, laying them out during the day and press-

* See F. C. Bulletin for 1886, p. 1.

† "*Saltning og Törring af Torsketunger.*" From the *Norsk Fiskeritidende*, Vol. V, Nos. 3 and 4, Bergen, October, 1886. Translated from the Danish by HERMAN JACOBSON.

ing them at night, until after three or four days they are ready for exportation to European markets. If intended for transportation to transatlantic countries, they must be dried better, about two weeks being sufficient. When half the drying process has been accomplished, the tongues should be pressed without interruption for three or four days.

In case of unfavorable weather the tongues are simply left in press, as they do not easily sour. They should, of course, not be exposed to rain, and when the weather looks threatening they should be taken in in time. They should also be taken in before the sun goes down, even if the air seems dry. The greatest trouble during drying is caused by the fog, which gives to the tongues a gray appearance, which should be avoided. They should, therefore, never be laid out in foggy weather, or whenever it looks as if there might be fog. Those tongues which are dried under shelter should under such circumstances be covered with tarpaulin.

The principal European market for salted and dried tongues is Spain. The Spaniards would rather have them a little soft than too hard. They are packed in wooden boxes of 3 kilograms ($6\frac{3}{5}$ pounds) or more. For the transatlantic market they are packed in tin boxes.

TRANSPORTING LOBSTERS IN NORWAY.*—The fast sailing vessels, with tanks, which formerly were used for transporting lobsters, have gradually been superseded by steamers, and lobsters are now almost exclusively transported in boxes placed on board the steamers. The boxes generally used for the purpose in Norway have the following outside dimensions: Length, 39 inches; breadth, 19 inches; and height, 15 inches. If ice is used they are made 4 inches lower. Each box contains from 100 to 120 lobsters. Sometimes smaller boxes are used, with the following dimensions: Length, 24 inches; breadth, 19; height, 13. Between the boards there should be suitable openings to admit fresh air.

In summer there is placed at the bottom of the box a layer of ice two or three inches thick, and on this a frame, so that the lobsters are not disturbed in their position even if the ice melts. On this frame there is first spread a thin layer of fresh heather (long, thin grass) or straw, on which the lobsters are laid carefully, back downward, the tail being bent forward and across the box, so the claws turn inside towards the center. When the box is full some heather or straw is spread over the lobsters and the box is closed. Heather is preferable to straw, as this easily spoils on account of the moisture caused by the ice, and the lobsters cannot well endure any bad odor.† For this reason it is not advisable to use dry sea-weeds, which formerly were often employed. Old sail-cloth dipped in sea-water forms an excellent cover, as it keeps moist

* "*Forsendelse af Hummer.*" From the *Norsk Fiskeritidende*, Bergen, Norway, October, 1886. Translated from the Danish by HERMAN JACOBSON.

†As the boxes are generally, on board the steamers, piled one on the top of another, the layer of straw or heather should not be too thin, for the object of the covering is partly to absorb the ice-water from the upper boxes, so that it does not reach the lobsters.

and cool for a long time. If one has no ice, heather soaked in sea-water may be used, dry fresh straw, or sail-cloth. During the cooler season only heather or straw should be placed at the top and bottom of the box.

In winter the sides of the box may be lined on the inside with paper, so as to protect the lobsters against the cold, but there should not be any paper either at the top or bottom, as the lobsters would be stifled, owing to the lack of air. When the lobsters have not been kept prisoners for more than eight days, they will, when packed in boxes in the manner described above, keep for four days. The fresher the lobsters the better will they be able to stand the fatigue of the voyage.

The boxes are placed on the deck in such a position that the water from the melting ice does not reach the lobsters, which cannot well endure fresh water, and so that the lobsters are protected against rain, as rain-water is very apt to injure them. Lobsters which during transportation have been exposed to the rain, when placed in tanks will generally lose their claws. The persons who ship lobsters should therefore see to it that the boxes are placed in proper position on board the steamer. It is best to place the boxes containing lobsters on the fore part of the steamer, so that the lobsters may get the benefit of the spray from the waves.

Shad in North Carolina.—The following extracts are made from the Weekly News, of Fayetteville, N. C., Mr. S. G. Worth, late fish commissioner of the State, being its editor:

From persons who handle about 95 per cent of the fish in the lower part of the Cape Fear River, it is learned that the catch of shad up to the first part of April is double that of last year, when more shad were caught than in any previous season. The season here begins with February and lasts three months. Thus far, from careful estimates, 60,000 shad have been caught at the fisheries below Wilmington. With one month's more time in which to run the seines, the season's catch may safely be estimated at 100,000 fish. The greater part of the catch is made by seines in the river, there being 140 men engaged in the shad fisheries below Wilmington, using 70 nets.

It is stated on good authority that Cape Fear River shad are the best caught on the Atlantic coast, being larger and of more delicate flavor than those from the Connecticut, the Delaware, or Savannah. Large numbers of Connecticut shad, however, are being taken in the Cape Fear this season, the river having been partly stocked with young shad from the Connecticut in 1876 and subsequent years.

Many more shad than usual have been caught up the Northeast Cape Fear this season, residents saying that they have never before seen fish so abundant. The yield of the shad fishery for the State may be placed at $1,000,000 a year.

Fayetteville, N. C., *April* 7, 1886.

Vol. VI, No. 21. Washington, D. C. Dec. 20, 1886.

99.—PEARLS AND PEARL FISHERIES.*

By Engineer M. WEBER.

Many mussels cover the inside of their shell with a layer consisting of animal membranes and carbonated lime. Thereby a peculiar luster is produced on the inside of the shell, which is called mother-of-pearl. A smaller portion of this secretion often forms excrescences shaped like drops or kidneys, which either are imbedded more or less firmly in the inside of the shell, or lie loose in the soft parts of the animal, especially in its so-called beard. These are what are generally known as pearls.

The formation of mother-of-pearl is doubtless a natural process taking place in certain mussels. The formation of pearls, on the other hand, is ascribed to accidents, and probably is caused by a sickness of the mussel, or by some wound inflicted on it. This view has been reached by noticing the circumstance that, when the shells are large, and the inside smooth, clean, and without any holes, so that the mollusks can fully develop, pearls are but rarely found; while the formation of pearls is very frequent when the shells are irregular. Sometimes hundreds of pearls are found in the last-mentioned shells; but frequently scarcely one of them possesses any commercial value.

Real pearls are found only in bivalves; but a useful product is found in some univalves. The products of the following varieties are known in commerce:

(1) *Avicula margaritifera.*—Which produces the most valuable pearls, but whose shell is worthless.

(2) *Meleagrina margaritifera.*—Principally valued on account of the mother-of-pearl. The shells are often 6 to 18 inches long. Its pearls are also of great value.

(3) *Strombus gigas.*—The conch-shell of the West Indies.

(4) *Tridacna gigas.*—The giant clam, with opal white pearls of a subdued luster.

(5) *Pinna squamosa.*—With black and red pearls.

(6) *Placuna placenta.*—Translucent, with lead-colored pearls.

(7) *Ostrea edulis.*—The common oyster.

(8) *Modiola vulgaris.*—The horse-mussel.

(9) *Turbinella scolymus.*—The chank-shell; pale-red pearls.

(10) *Turbo olearius marmoratus.*

---

* "*Om Perler og Perlefiskerierne.*" From the *Norsk Fiskeritidende*, Bergen, Norway, October, 1886. Translated from the Danish by HERMAN JACOBSON.

An excellent reference in this connection is to the chapter on Pearls and the Pearl Fisheries, in P. L. Simmonds's Commercial Products of the Sea.

(11) *Turbo sarmaticus.*

(12) *Haliotis* (different varieties).—Found in the North Sea, New Zealand, the Cape of Good Hope, and Japan.

(13) *Anodonta herculea.*

(14) *Alamodon, Unio, &c.*—Found in Scotland, Ireland, Lapland, Bohemia, Bavaria, Saxony, and Canada.

The sea pearl fisheries are principally confined to the Persian Gulf the coasts of Ceylon, the Eastern Archipelago, Australia, the lagoons of many islands in the Pacific, and to Central America.

Fresh-water pearls have, as a rule, but little luster, and are consequently of no great value; although one occasionally finds pearls having a value of from 50 to 70 crowns [$13.40 to $18.76], and sometimes even of 1,800 crowns [$482.40]. For a while the Scotch pearls enjoyed a great reputation. From 1761 to 1764 more than 180,000 crowns' [$48,240] worth of pearls are said to have been brought to London from the rivers Tay and Isla. During the dry summer of 1862 a surprising quantity of pearls was found in Scotland. The average value of these pearls varied between 40 and 45 crowns [$10.72 to $12.06], but those valued at 100 crowns [$26.80] were also quite frequent. Statisticians estimate that the total value of pearls found in Scotland in 1865 was 216,000 crowns [57,888]. Since that time pearls have advanced considerably in value.

During the summer months the Arabs carry on a sort of pearl fishery on the coast of the Red Sea. They catch the mollusks and lay them in the sun, so that they may open quickly. Jedda is the principal place where these fisheries are carried on. The exportation of mother-of-pearl from Jedda *via* Alexandria annually amounts to 1,200,000 pounds avoirdupois, half of which quantity goes to Birmingham.

The pearl fisheries in the Persian Gulf, especially on the coasts of the Island of Bahrein, are also in the hands of the Arabs. The best beds are said to be on fine white sand and in clear water. Nearly 5,000 boats are employed in these fisheries, and their annual value is estimated at 1,080,000 crowns [$289,440]. Beds of pearls are found at various depths as far down as 18 fathoms. The general depth at which they are found is, however, from 4 to 8 fathoms. The season lasts from April to September. Most of the shells are brought to the little harbor of Lingah; thence a considerable quantity of mother-of-pearl is shipped direct to London, only a small quantity going to the continent of Europe. Many pearls, especially those of a yellow color and those having a complete cone-shape, are sent to Bombay. Bagdad is a considerable market for white pearls. The shells which come to England from Persia are mostly small and have a subdued luster; but as a rule they bring higher prices than the Panama and Tahiti shells. The annual quantity imported is rarely less 300,000 pounds. The total value of the pearls exported from the Persian Gulf during 1879 was 7,500,000 crowns [$2,010,000].

The Ceylon pearl fisheries are carried on on the west coast of Ceylon, in the Gulf of Manaar, south of the island of the same name, and also on the west coast of India, near Tuticorin. The beds lie in groups. One of these is opposite the town of Arippu, and comprises the so-called Paria-par, Paria-par Karai, Cheval-par, Kallutidel-par, and Modaragam-par. The famous Karaitivu bed is opposite the town of that name. Other well-known beds are the Karakupanai-par, and the Jekenpedai-par. All these beds lie at a distance of at least 6 to 8 miles from the coast, and at a depth of 5½ to 8½ fathoms from the surface. They have a rocky bottom protruding from the sand, and are exposed to the currents of the sea. The beds are under the supervision of an inspector appointed by the local government, which has the exclusive working of them. The laborers and divers are natives, who as payment receive 25 per cent of all the pearls they find. Experience has shown that few pearls, and these of little value, come from mussels which are not older than five years. During the fifth and sixth year the value doubles, and in the seventh year it becomes fourfold. The pearls are not fully matured if they are taken out too soon; and on the other hand, the animal dies, if the pearls remain too long in the shells. For these reasons pearl fishing is prohibited at certain periods.

Up to the year 1863 there was no system in these fisheries. The results were as follows:

Years.	Crowns.	Equivalent in United States currency.
1796–1809	9,314,658	$2,496,328
1814–1820	1,618,362	433,721
1828–1837	4,088,376	1,095,685
1855–1860	2,114,172	566,598

In 1863 there were caught on twenty-two fishing days 11,695,000 pearl-oysters, yielding pearls to the value of 918,324 crowns [$246,110.83]. The next fisheries were in 1874, when 1,700,000 pearl-oysters yielded 182,160 crowns' [$48,818.88] worth of pearls. In 1877 there were caught on thirty fishing days 6,850,000 pearl-oysters, yielding pearls to the value of 341,136 crowns [$91,424.45]. The yield in 1879 was unusually good, as twelve fishing days yielded 7,650,000 pearl-oysters. In 1880 the fisheries lasted from March 19 till April 2, and during these eleven days 11,000,000 pearl-oysters were caught. In 1881 as many as 60,000,000 were caught, yielding pearls to the value of 1,080,000 crowns [$289,440]. These fisheries are now carried on according to a well-regulated system. The divers receive their wages as soon as they reach the coast.

When the pearls have been gathered, they are classified in the following manner:

(1) "Anie," pearl-eyes; that is, pearls of perfectly round shape and pure luster.

(2) "Anathorie," that is, pearls which have a slight defect in either of these respects.

(3) "Masengoe," pearls which have defects in both these respects.

(4) "Kalippo," pearls which are flat, and have other great defects.

(5) "Korowel," faulty pearls, especially double pearls.

(6) "Peesal," misshaped pearls.

(7) "Codwee," misshaped pearls of tolerably fine form.

(8) "Mandongoe," split pearls.

(9) "Kural," very small misshaped pearls.

(10) "Thool," seed-pearls.

In sorting the pearls they are first passed through a row of baskets, 10 or 12 in number. The eighth basket in the row has 20 holes, and the pearls which do not pass through these are said to have the "twentieth measure." The following baskets have 30, 50, 80, 100, 200, 400, 600, 1,000 holes, &c., and each basket has its special name. After the pearls have been sorted in this manner, they are weighed, and their value is noted.

China has pearl fisheries near Pakhoi. The beds are divided into four districts which lie between the south coast of the peninsula of Pakhoi, the island of Weichow, and the peninsula of Leichow. In 1875 these fisheries yielded pearls to the value of about 162,000 crowns [$43,416]. Cochin China carries on an extensive trade in mother-of-pearl, most of which comes from the Bay of Tirwar. On the north coast of Japan considerable quantities of *Haliotis gigantea* are caught, which is highly prized by both the Japanese and Chinese.

The Philippine Islands produce large quantities of mother-of-pearl. In 1877, 155 tons were exported; in 1878, 152 tons, valued at 307,314 crowns [$82,360.15]; in 1879 the yield amounted to 288,810 crowns [$77,401.08]. The entire region from the island of Tawi-Tawi and Sulu to Baselan is one continuous bed of pearl-oysters. Here the Malays and Chinese fish in common. The Sulu fisheries, near Tawi-Tawi, are, according to the statement of an Englishman, Mr. Moore, the largest and most productive of all the pearl fisheries in the East Asiatic seas. The pearls which are caught here have always been famous, and the mother-of-pearl is distinguished by its yellow luster, which makes it suitable for many purposes. Labuan is the principal market for the products of Sulu. In 1868 the value of these pearl fisheries was 207,972 crowns [$55,736.50]; in 1870 it fell to 102,348 crowns [$27,429.26]; and up to 1878 it fell still more. Macassar is the principal market for the natives from Bayos. In the Kau Bay there are found pearl beds belonging to the Sultan of Ternate. Pearls and mother-of-pearl are found near the island of Aru, and are brought to market at Debbo. The principal place where these fisheries are carried on, however, is Blakong Tanah, opposite the island of New Guinea; and these are really the most important fisheries in the entire archipelago. The yield in 1860 amounted to 133,000 crowns [$35,644]. The island of Timor has pearl beds, but the yield is small.

The most important pearl fisheries in Queensland are in the hands of Sydney capitalists. The fisheries are carried on by Malays, who dive to a depth of 6 fathoms. The pearl-oyster from Torres Strait generally weighs from 3 to 6 pounds, and sometimes as much as 10 pounds.

The value and weight of the mother-of-pearl exported from Queensland was as follows:

Years.	Weight.	Value.	Equivalent in United States currency.
	Pounds.	*Crowns.*	*Dollars.*
1874	2	216	57 89
1875	11,200	14,382	3,854 38
1876	288,600	281,970	75,567 96
1877	776,800	877,014	235,039 75
1878	953,000	974,682	261,214 78

The pearl fisheries on the northwest coast of Australia employ a large number of Malays and natives as divers. The fisheries last from the end of September till the end of March. It has not yet been possible to ascertain the extent of the beds; it is supposed, however, that they extend as far as the Gulf of Carpentaria. The fisheries are carried on for the shells, but frequently yield pearls of considerable value. These shells are the best which are known. They weigh from 1½ to 6 pounds a pair. The export duty is 72 crowns [$19.30] per ton. The oldest fisheries in West Australia are carried on in Sharks Bay. The shells which are caught here are those of the *Avicula margaritifera*. They are very thin, but their inside surface is transparent and has a beautiful pearl-like luster. At present they fetch a good price at Havre. Formerly they were but little esteemed on account of their thinness, and for this reason they were taken principally on account of their pearls. These have a brilliant luster, although they are not larger than a pea. The oysters are caught with a wire drag-net, which is drawn across the beds, and which piles them in a heap; thereby the mollusk is killed, and the shells are easy to open. The West Australian pearl fisheries increase from year to year. In 1874 mother-of-pearl was exported to the value of 1,060,707 crowns [$284,269.48], and pearls worth 108,000 crowns [$28,944]. In 1876 there were exported to London 140 tons, and to Singapore 67 tons, the price varying from 4,500 to 4,840 crowns [$1,206 to $1,297.12] per ton. Recently the English papers have reported the discovery of pearls and mother-of-pearl near New Zealand.

Diving for pearls is one of the principal employments for the natives of the Pacific Ocean. Here, likewise, mother-of-pearl is the principal object of the fisheries. The oysters live in large colonies, close together, and are firmly attached to each other; they are attached to the bottom by a ligament or band, starting from their body and running through the shell. In the live animal this band is of a dark green, and sometimes gold-bronze color, and the fishermen can tell from its color whether

the shells contain pearls or not. The shells reach their full size when they are seven years old. The average weight of the empty shell at that time is about 1 pound, and the length varies from 10 to 18 inches. When the animal has reached maturity, it tears itself loose from the stones, opens its shell, and dies. The shells are then covered with corals and parasites. They become worthless and the pearls are lost. These mollusks also have a number of enemies, the most dangerous of which is a kind of *Scolopendra*, which opens the shells and eats the mollusks. All grown mussels are, moreover, infested by crustacean-like parasites, which penetrate into the shells and there lay their eggs.

After the oysters have been caught and brought ashore by the divers, they are sorted. The shells are opened with a steel knife. A skilled hand can open a ton per day, and not miss a single pearl. The mother-of-pearl is laid in a shady place, that the colors may not fade. When there is a famine, the mollusks are eaten by the natives. The pearls are generally found in the place where the band before mentioned starts. In shells where many pearls are found, they are generally small and misshaped. Occasionally pearls are found loose in the shells. These are always of a very fine quality, perfectly round, and often very large. But there is hardly one in a thousand oysters which contains such pearls. The natives often lose them, owing to the careless way in which they open the shells.

Fine and calm weather is most favorable for pearl fishing. The divers wear no special suit, but simply rub their body with oil, so the sun may not blister their skin. They remain under the water one to two minutes, and bring up oysters from a depth of 20 fathoms. They rarely go to such a depth, but the finest oysters are found there. Thus in many fishing-grounds, which were supposed to be exhausted, a great many pearl-oysters are found in deep water.

In the Southern Pacific, pearl fisheries are principally carried on near the Navigator's Islands in the Tuamotu Archipelago. Many of these fishing-grounds are partly and some are entirely neglected. Thus the Island of Manihiki twenty years ago yielded 100 tons of shells in eighteen months; but since that time no pearl fisheries have been carried on there. The Hogolen Lagoon is also known as a vast unexplored pearl-oyster bed. So far the Tuamotu Archipelogo is said to have produced 25,000 tons of mother-of-pearl, valued at 18,000,000 crowns [$4,824,000]. Nearly the entire quantity goes to Tahiti, to be exported thence. In 1873 2,000 tons of shells were exported; the pearls having a value of about 140,000 crowns [$37,520]. In 1878 Tahiti exported 591 tons of shells, valued at 638,280 crowns [$171,059.04], and pearls valued at 108,000 crowns [$28,944]. In 1879 there were exported 470 tons of shells, valued at 507,600 crowns [$136,036.80], and pearls valued at 72,000 crowns [$19,296]. In 1875 an export duty of 30 crowns [$8.04] per ton was levied; this duty, however, was abolished in 1878, and since that time the exportation has again increased.

On the islands of the Pacific the pearls are classified as follows:*

(1) Pearls of a regular form and without faults; in value, those weighing a decigram, are worth about 2.7 crowns [$0.72]; those weighing from 1½ to 2½ grams, from 1,800 to 2,600 crowns [$482.40 to $696.80].

(2) Round white pearls of great luster; 30 grams, containing 800 pearls, would be worth only 72 crowns [$19.30]; while the same weight in 50 pearls would be worth 1,080 crowns [$289.44].

(3) Irregularly formed pearls, not without faults; 30 grams of this kind would be worth 55 to 75 crowns [14.74 to $20.10], according to their condition.

(4) Pearl-bulbs, which are found attached to the shells; 30 grams are worth from 25 to 36 crowns [$6.70 to $9.65], according to their regularity of form and brilliancy.

(5) Seed-pearls, which are worth from 36 to 55 crowns [$9.65 to $14.74] per pound.

Mother-of-pearl fetches from 25 to 50 öre [6½ to 13½ cents] per pound. The principal markets for pearls from the Pacific are Hamburg, Amsterdam, London, and St. Petersburg.

Besides the pearl-oyster, there is often found in the lagoons of the Pacific Ocean a kind of *Venus* shell, which often contains pearls of great value. The fishermen do not look for these pearls at all, but it is presumed that it would pay to examine these shells more systematically.

In the Pacific there is found another pearl-producing mollusk, whose shells greatly resemble those of the common oyster. They are always found attached to rocks, invariably one by itself; and they are quite rare. Their pearls are always perfectly round, with a fine luster and a gold color, of about the size of a pea.

The Central American pearl fisheries are carried on on both sides of the Isthmus of Panama. In the Bay of Panama are located the Pearl Islands, of which San José is the most important, yielding every year from 800 to 1,000 tons of mother-of-pearl. In 1869 the English imported pearls valued at about 800,000 crowns [$214,400] from New Granada and St. Thomas; while the average annual yield of the Panama fisheries is about 500,000 crowns [$134,000]. In the lower part of the Bay of Mulege, in the Gulf of California, and near Los Coyutes, pearls of great value have been found. It is generally supposed that a row of pearl beds extends from the Gulf of Darien to California. In the last-mentioned bays, and on the coasts of Costa Rica and Central Mexico, pearl fishing has long been a remunerative employment. The principal fisheries on the Mexican coasts are carried on between Mulege and Cape San Lucas. Near the Islas Tres Marias and in the neighborhood of Acapulco the fisheries are not near so important. The mollusks found are *Meleagrina margaritifera* and *Haliotis rufescens*.

The fisheries are carried on from July till October; during the rest of the year storms and cold weather prevent fishing. Diving suits are

* See Simmonds's Commercial Products of the Sea, p. 425 (Part III, Chap. III).

generally used. The mother-of-pearl from the Gulf of California is white, with bluish-black or yellow bands. The fisheries were carried on to such an excess that the size of the shells decreased from year to year; fishing is therefore now permitted only every fourth year. The California shells are sent almost exclusively to Hamburg, whence they go to England, Austria, and France. The largest quantity goes to Paris, but a great deal also to Frankfort on the Main. The entire California fisheries are said to produce from 600,000 to 700,000 pounds of mother-of-pearl per annum. In 1879 Costa Rica exported 3,540 pounds. In the same year Panama sent pearls to the value of 126,000 crowns [$33,768] to the New York market. Guayaquil, in 1871, exported 13 to 14 tons of mother-of-pearl. In the Bahamas the snail fisheries form an important industry. The pearls found in them are rose-colored, yellow, or black; the first mentioned alone possess any value. The market for these pearls is Nassau, in the Bahamas; and it frequently happens that a pearl fetches as much as 400 crowns [$107.20]. The average annual yield is 180,000 crowns [$48,240]. In the State of Ohio pearl fisheries are carried on in Little Miami River. The season lasts from June till October. Men and boys wade in the river and bring up the pearl-oysters with their feet. The shells are opened with a knife; and seldom are more than 2 pearls found in 300 oysters. Pearl fisheries are also carried on in the rivers of Norway, Bavaria, and Bohemia.

100.—NOTES ON THE NEW ENGLAND FISHERIES IN OCTOBER, 1886.

By W. A. WILCOX.

During most of the month the weather was favorable for fishing, the exceptions being high winds that held mackerel seiners in the harbors of Cape Breton a large part of the month, and a long storm off the New England coast the last week in the month.

Codfish show an increase of 474,758 pounds in the amount landed at Gloucester over the corresponding month of last year, the receipts being mostly from Western Bank. One year ago cod were very abundant on George's Bank, but few if any were caught on Western Bank; this season affairs are reversed. For several months fish have been reported scarce on George's and very plentiful on Western Bank. Off the New England coast cod have been more abundant than of late years. Many vessels engaged in cod-fishing could show a large amount of fish caught during the year. Among others we notice that the schooner Finance, of Gloucester, from October 2, 1885, to October 15, 1886, with a crew of 11 men, including the master, has landed 600,000 pounds of codfish and 20,000 pounds of halibut, most of the catch being taken on George's and Brown's Banks.

Vessels engaged in the halibut fishery have found fish fairly plentiful on Grand and Quereau Banks, Gloucester vessels having arrived

with good fares, landing 620,930 pounds more than during the corresponding month of last year.

Mackerel have continued scarce both off the United States and provincial shores. The first of the month 75 sail of seiners from New England ports were off Prince Edward Island, and 100 sail were scattered along the New England coast. The fleet left Prince Edward Island the first week in the month, most of them returning to home ports, some with good fares, but most of them with only a small amount; total receipts of mackerel at all home ports from off provincial shores, 69 fares, with 12,421 barrels, an average of 180 barrels, which is not half a full fare. After leaving the island a small fleet remained off Cape Breton all the month. On October 11 and 23 they took a few hundred barrels of mackerel, but most of the month vessels were detained in harbors by strong winds and unfavorable weather for fishing; seiners after returnfrom the Gulf of Saint Lawrence, hauled up, or joined the fleet off the New England coast. Mackerel were found off the Massachusetts coast, mostly in Barnstable Bay, and off Block Island, all the month, seldom in any great quantities. The fish were of mixed sizes, a good proportion large, and quality fine.

On October 20 mackerel were very plentiful off Sandwich, Mass., 26 sail arriving in Boston the next day, with small fares, aggregating 826 barrels of fresh mackerel and 113 barrels of sea-packed, the fish being of mixed sizes. These fish were mostly taken in the night, the seine being thrown around the vessel; after being pursed up, the vessel is sailed out of the seine, passing over the cork-line, and the fish removed. Sometimes bait is thrown to call the fish alongside of the vessel, and then vessel and fish are quickly surrounded by the seine.

An immense body of small herring during a large part of the month was in the neighborhood of Gay Head, Vineyard Sound. Mackerel were mixed with them, and a few vessels had a fair catch hooking the mackerel, the size being mostly large and quality fine.

Owing to the scarcity of the fish, prices of mackerel have steadily advanced from $13.50 a barrel, sea-packed, for North Bay catch, at the first of the month, to $16 at the close; extra large and fine mackerel caught off the New England coast found quick sale at from $25 to $40 a barrel. The fishermen have been encouraged by the high prices to use every exertion to take fish, more bait and hooks having been used than for several years.

Three vessels on long mackerel trips did not take seines, depending on the hook and line, the first time for years; they report as follows: Schooners M. L. Wetherell and William V. Hutchins sailed from Gloucester to the Gulf of Saint Lawrence, going as far as the Magdalen Islands, spending the entire season, and catching only 42 and 33 barrels of mackerel, respectively; schooner Maria Webster, of Wellfleet, used hooks exclusively, for two months' fishing only, off the Massachusetts and Rhode Island shores, taking 161 barrels of fine mackerel.

The great falling off in the mackerel catch is of interest. Total amount

landed, in sea-packed barrels, at all New England home ports up to October 28:

1886	74,387
1885	324,704
1884	411,08
1883	189,271

In common with most of the leading food-fishes, cod excepted, pollock have been scarce, hand-lines and gill-nets both taking only a small amount. The total quantity landed at Gloucester during the month was 398,250 pounds, against 3,142,790 pounds for the corresponding month last year.

The first set of gill-nets this season was made 7 miles out from Gloucester, on October 7. Being hauled the next day the catch found was twenty-five pollock, averaging 21 pounds each, two-thirds female fish, mostly full of spawn. They sold for $1.25 per 100 pounds. As the catch increased the price fell to 50 cents per 100 pounds.

Bait has continued abundant and more than enough for all demands. Weirs along the eastern coast, from New Castle, N. H., to Southwest Harbor, Maine, have had plenty of herring, while weirs at Cape Cod had a smaller amount of herring and mackerel. On the Western Bank, where most of the codfish were caught, squid were very plentiful, furnishing the best of bait free of expense.

Shore herring remained along the Massachusetts coast, in the vicinity of Cape Ann, most of the month, but in no large body, excepting on October 3 and 4, when they were off Rockport, Mass., in immense numbers, and the fishermen had more than they could handle, and many nets were sunk by the weight of the fish. Anticipating a large catch, prices fell to 75 cents to $1 a barrel. The herring soon struck off, a smaller body of fish appearing off the Eastern Point and along the Massachusetts shore. Prices soon advanced to $1.50 and $1.75 a barrel. The total catch of large shore herring taken off the Massachusetts coast has not been one-half that of 1885.

The halibut fleet from Iceland have all arrived, bringing fair but not full cargoes. Two sailed, early in the season, for Greenland on halibut trips, one returned with partial cargo, and one (mentioned below) is probably lost.

A sad record of loss of life and property closes the report for the month. Four vessels have sailed from Gloucester never to return, when and how three of them were lost will probably never be known. During the past month the following have been given up:

On October 3 the schooner Garibaldi, 49.89 tons, on a codfish trip, was burned while at anchor in Schooner Passage near Yarmouth, Nova Scotia, the crew being all saved.

Schooner John F. Wonson, 53.13 tons, sailed on August 4 for codfish on George's Bank; since that time she has not been seen, and the vessel and crew of 10 men are given up.

Schooner Seth Stockbridge, 85.44 tons, sailed in June on a halibut

trip off Greenland. She carried 14 men, and has never been spoken since, but is supposed to have been lost in the ice-fields of the far north.

Schooner George L. Smith, 84.28 tons, sailed August 14 on a halibut trip to Quereau Bank, and was last seen on Brown's Bank on August 21. The vessel and 14 men are now given up. All the above vessels were owned and sailed from Gloucester, and were fine vessels. Total loss, 38 men and 4 vessels; 274.74 net tonnage.

Fish landed at Gloucester, Mass., by Gloucester vessels, in October, 1886.

From—	Fares.	Codfish.	Halibut.	Hake.	Haddock.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Western Bank	67	3,147,000			
George's Bank	39	723,000	227,200	26,000	25,000
Quereau Bank	26		617,000		
Jeffrey's Bank	2	2,000			
Iceland	3		330,000		
Grand Banks	12	1,460,000	188,500		
Bay of Fundy	2	25,000	400	2,000	
New England shore	62				
New England shore	44	65,050		127,000	20,000
New England shore, gill-nets	105	39,580			
Brown's Bank	2	70,000			
Gulf of Saint Lawrence	53				
New England shore	29				
Shore, small boats		50,500		5,000	
Long Island Sound	3				
Total in October, 1886	449	5,582,130	1,363,100	160,000	45,000
Total in October, 1885	560	5,107,372	742,170	282,002	74,334

From—	Pollock.	Cusk.	Herring.	Mackerel.	Menhaden.
	Pounds.	*Pounds.*	*Barrels.*	*Barrels.*	*Barrels.*
Western Bank					
George's Bank		4,000			
Quereau Bank					
Jeffrey's Bank	10,000				
Iceland					
Grand Banks					
Bay of Fundy	2,000				
New England shore			8,033		
New England shore	71,650	6,000			
New England shore, gill-nets	314,000				
Brown's Bank					
Gulf of Saint Lawrence				10,031	
New England shore				1,067	
Shore, small boats	600		50		
Long Island Sound					510
Total in October, 1886	398,250	10,000	8,083	11,098	510
Total in October, 1885	3,142,790	4,500	4,321	30,915	

Receipts of fish from outside vessels at Gloucester, Mass., during October, 1886.

From Maine and New Brunswick:		
Cargoes of dry, pickled, and smoked fish		13
Hake	quintals..	7,100
Haddock	do....	700
Pollock	do....	25
Cod	do....	480
Cusk	do....	435
Smoked herring	boxes..	14,000
Bloaters	do....	100
Pickled herring	barrels..	100
From Tiverton, R. I.:		
Menhaden oil	barrels..	450

GLOUCESTER, MASS., *October* 30, 1886.

101.—SALMON IN THE CLACKAMAS RIVER.*

By A. S. ABERNETHY.

[From a letter to Senator J. N. Dolph.]

I was engaged in salmon fishing in the Clackamas during the fishing season of 1886, from about April 10 until July 10. Most of the time we fished about 1 mile below the mouth of Clear Creek, where the hatchery was operated some years ago. During the three months named we caught about 900 Chinook salmon, with one boat and drift-net, and about five short set-nets. There were several parties fishing at the same time, and their average was about the same. One man, who put in a trap above the mouth of Eagle Creek, several miles above Clear Creek, claims to have caught about 75 per day. I am certainly within bounds when I say that within the time named there were 3,500 salmon caught by all the parties engaged in the business.

After the middle of July the fish became soft and unfit for market, so no more fishing was done; but they continued to run, and parties who went up as late as October 15 to fish for silver salmon caught large numbers of Chinook salmon too old to be marketable but full of spawn. For several nights one man got about 25 per night mixed in with the silver salmon. There was no fishing done in the river during the month of March, when the run was very large. The figures I have given refer only to Chinook salmon.

It might be well to call attention also to the other two varieties that frequent the river in large numbers.

The silver salmon runs from about the middle of September to the middle of December, and is almost equal in quality to the Chinook. It runs in the Clackamas, but appears to go no farther up the Willamette than the mouth of the Clackamas. I am told that it is not caught at Oregon City.

The steel-head runs from about December 1 to February 15, and is very abundant in the Clackamas. This fish is not so much in demand in the Oregon markets as is the Chinook; but sells very readily in all Eastern cities, where it seems to be generally preferred to the Chinook, and large numbers are shipped fresh, packed in ice.

There is very little time in the year when some one of the three kinds of fish is not running in the river; and a hatchery could be kept in operation nearly or quite all the year. I will try to get the actual figures of the catch of each kind of fish during the next season, which will perhaps furnish a better idea of the number than can otherwise be had.

PORTLAND, OREG., *November* 29, 1886.

---

* For article by Mr. Barin on the same subject, see this Bulletin (1886), p. 111.

102.—THE TREPANG FISHERY.

By JAMES G. SWAN.

[Abstract.]

An important fishery for a food product, although one scarcely known in Europe or the United States, is that carried on for trepangs in the South Pacific and Indian Oceans, where it is found chiefly on coral reefs, from which it is gathered and imported in large quantities into China, where it is considered a great culinary delicacy. The trepang is found in all latitudes, but hitherto the supply has come mainly from the islands of Oceanica, particularly New Caledonia. In Malaysia, the Ladrones, and the China Sea, thousands of junks are equipped annually for these fisheries. The island of Erromanga, in the New Hebrides, has long been an important shipping point for this product.

The trepang, or beche-de-mer, as it is often called—another of its names being the sea-cucumber—is a rather repulsive looking animal, being a kind of sea-slug belonging to the genus *Holothuria*. There are several varieties. The ordinary kind which is used for food (*Holothuria edulis*) resembles somewhat a prickly cucumber in size and appearance, except that the color is a light brown with a yellow belly. Another kind is black. Sometimes they are found nearly 2 feet in length; but they are generally much smaller, and about 8 or 10 inches may be taken as the average length.

The trepang, when prepared for market, is an ugly looking, brown-colored substance, very hard and rigid, and can be eaten only after being softened by water and a lengthened process of cooking, when it is reduced to a sort of thick soup by the Chinese, who are very fond of it; and when cooked by a Chinaman who understands the art, it makes an excellent dish which the Europeans at Manila regard very highly.

The preparation of the trepang for market is simple. They are to be boiled in water, either salt or fresh, for about twenty minutes, and then slit open, cleaned, and dried. Those dried in the open air or sunshine bring a higher price than those dried over a wood fire, which latter is the usual process adopted by the Malays. Some varieties require boiling for only a few minutes, or till they become firm to the touch. They must be dried thoroughly, as they absorb moisture readily, and are then liable to become moldy and spoil.

No one has yet attempted this fishing in the North Pacific, although trepangs abound in the waters along the northwestern coast of America, particularly in the region of the Queen Charlotte Islands and the Alexander Islands of Alaska, as well as on the west coast of Vancouver Island. Some time ago an Indian brought me two good specimens,

which he had caught at low tide near the end of the mill wharf at Point Hudson. I showed them to several Chinamen, who at once pronounced them to be the best quality of "whetong," one of the Chinese names for the trepang.

When properly cured they are a valuable food product, and will sell in Canton for about $45 per ton. This indicates that there may be a deal of money in the business, if rightly conducted, as a cargo of a hundred tons could easily be cured at some places in a few months with a sufficient force of Indians to collect them. The cost is simply to gather the trepangs at low tide, or have the Indians do so, and then have them properly dried, which is an easy process, though one requiring some care and skill. A few inexpensive experiments will enable one to ascertain the correct way of preparing these slugs, which will be likely to find a ready and lucrative sale to the Chinese merchants.

PORT TOWNSEND, WASH., *March* 19, 1884.

103.—SALMON IN THE McCLOUD RIVER DURING THE SEASON OF 1886.

By LOREN W. GREEN.

The first run of salmon for this season appeared at the mouth of the McCloud River on May 15. The run was comparatively small in number, and the fish were unusually bright and healthy. This was owing to the uncommonly high water, which continued till late in the spring, and gave the fish a much better chance to ascend the steep and rocky riffles, thus making their journey from the ocean a much quicker one than is usual at low water. It is well known that salmon take no food after leaving salt water, and the state of the water during their upward journey has much to do with their appearance on arriving at the headwaters. Nearly all of this run, which was about five days in passing, went up to the extreme limit of their spawning-grounds, where they deposited their ova.

About the last of May another small run arrived, and for some time salmon were abundant and much above the average in size. By the middle of June the water was muddy and the Indians were catching no fish. On June 20 a small run was passing up the McCloud, and another was just starting in from the ocean. On the 25th they were still coming in small numbers; and on July 5 a small run arrived, the fish being larger than any before known here. By the last of July there were no salmon, and the water was clear and low.

On August 21 a good run was reported at the mouth of Sacramento River, and on the 28th they arrived at the McCloud River Station in great numbers and excellent condition, some weighing as much as 45 pounds. By September 10 a considerable number of dead salmon were floating down the river; while by the middle of the month many salmon

were on the riffles, washing the gravel and spawning; and the two runs met here on the 17th,* the one coming up bright and fresh, the other falling back dead, or so nearly exhausted as to be unable to stem the current. On the 25th the fish were dying rapidly, and by the last of the month no salmon were in the river.

On October 6 a new run came on, large but few; and on the 15th another run arrived. On the 20th a large run appeared, many being in a spawning condition; and at the end of the month salmon were plentiful and spawning freely. Soon after they were dying in great numbers, while new runs were continually arriving.

On November 20 the largest run of the season (thus far) reached here, and were spawning freely. Nearly all were large fish, some dead and others dying, but the riffles were covered with fresh ones, and the bed of the river on the riffles was washed perfectly clean. By the 24th salmon were scarce, and considerable numbers of large dead ones were to be seen along the shore.

There is no doubt but that the large numbers of salmon which have visited the McCloud this season, and which are so much above the average of past seasons in size, are the salmon which were hatched at the McCloud Station by the U. S. Fish Commission and planted in the McCloud, Little Sacramento, and Pitt Rivers late in the fall of 1881. About 7,500,000 eggs were taken at this station during the season of 1881, and it is safe to say that more than 6,500,000 strong and healthy young salmon were planted in that year. The young fish were kept and well cared for until able to guard against their natural enemies; and the waters which carried them to the ocean were so favorable that nearly all must have reached it in safety.

The fish when planted, being strong and large, instead of sinking to the bottom and burying themselves in the gravel, as younger fish will do where numerous enemies are awaiting them, immediately began searching for food. For several days they kept together and took an upward course, searching along near the shore and gradually separating. By the following June many of them had reached points 10 or 15 miles above where they were planted. On August 23, 1882, using a handful of dried salmon eggs to entice them within reach, with a small dip-net I captured 48 at one dip, some of which would measure from 4 to 7 inches in length. This was at a point 8 miles above the place of planting. A few days afterwards there was a rise in the river which carried the young salmon out of the McCloud and on their way to the ocean, which they reached in safety, as the rise of water was not enough to overflow the broken levees.

In 1882 about 4,000,000 young salmon were planted at the McCloud Station; but owing to some trouble in the hatching-house they were planted somewhat younger than were those of the preceding year, and the water that carried them to the ocean was not so favorable and

* See Fish Commission Bulletin for 1886, p. 314.

many were carried through the broken levees, the percentage of loss being heavy. In 1883 about 1,000,000 were taken and hatched at the station and planted in the McCloud. Since then artificial hatching has ceased, and the number of salmon hatched from natural spawning in the river has been almost nothing. Never since 1882 could I call together more than three or four young salmon, and more often I would find none at all. Returns from the planting of 1881 have been beyond the most sanguine expectations, and millions of eggs could easily have been taken from salmon in the McCloud this season; but unless artificial hatching is again brought into operation in our rivers, our canneries must close, the Indians must suffer, and our beautiful mountain streams must soon have no salmon.

Comparatively few salmon have been up the Little Sacramento and Pitt Rivers this season. The blasting operations of the railroad along the line of the Little Sacramento have prevented the spawning salmon from ascending the stream as usual, quite a number having begun the ascent, but finding the gravel-beds covered and a general disturbance of the water, after a few days they turned back and came to the McCloud. The Pitt River received small runs late this fall; but for one salmon that goes up the Pitt a hundred ascend the McCloud.

Probably no salmon that deposit their eggs in the McCloud, Little Sacramento, or Pitt Rivers ever return to the ocean. On their arrival here they are generally of a silvery color, which soon deepens to a dark red; and after coming on the riffles and beginning to spawn, they fail rapidly. In washing the gravel their tails become white and threadbare, so to speak; soon a fungus covers their fins, which become stiff and of little use to the fish; parasites collect in the gills and throat; their eyes sink deep into the head; and their whole appearance changes greatly in a few days. Even in this condition they seem to care for nothing but to remain near the bed of gravel where their eggs are deposited, which they do until driven back by stronger fish or the swift current. When unable to remain longer they slowly drift down the river, with their heads up-stream, sometimes making quick darts with the current for a short distance, and then again facing up-stream. Often when driven near shore they swim to quiet places where the water moves slowly, and remain sometimes for two or three days with very little movement. At last they will start suddenly, lash the water into a foam, and sometimes jump their length out of water; but soon sink to the bottom or float down the river dead.

It is possible that some of the smaller male salmon that milt near the ocean find their way back to it alive and are saved by the salt water. From the river here I have taken salmon that were badly diseased, and by a few applications of salt water they greatly revived.

UNITED STATES TROUT PONDS,
Baird, Shasta County, California, November 24, 1886.

Vol. VI, No. 22. Washington, D. C. Dec. 20, 1886.

104.—THE ENEMIES OF POND CULTURE IN CENTRAL EUROPE.*

By Dr. BERTHOLD BENECKE.

In Central Europe the only mammals which commit depredations in fish ponds are the water-shrew and the otter.

The water-shrew (*Sorex fodiens* Pall.) is a pretty little animal, measuring 10 to 12 centimeters [about 4 inches] in length, including the tail, which is 5 to 7 centimeters [about 2½ inches] long. Its thick and soft fur is black on the back and sides, and whitish or grayish on the throat, breast, and belly. The snout is somewhat elongated, and can easily be moved in different directions. The helix of the ear is small; and when diving under the water, the animal can turn it over, so as to close the opening of the ear. The feet are bordered all round with bristles, which spread out in the water and form a good oar. Below the tail there is a keel-shaped row of long hairs. The water-shrew is very common in nearly all the waters of Europe, and lives in mouse-holes, or in burrows which it makes, and which have several openings, one of which is invariably below the water. It is an expert swimmer and diver, and eats insects, worms, and any other small animals which it can overpower. As it is exceedingly voracious, it becomes very dangerous to the spawn and young fry of fish; but it even attacks large fish, to which it clings like a leech and eats their eyes and brain. In hatching establishments especially it can do a great deal of harm by destroying the eggs and young fish, and also cause great injury in ponds and ditches, if found in large numbers. Hatching establishments must be protected against them by carefully stopping up all holes in the walls and the floor. The water-shrew can easily be caught in the neighborhood of the ponds in mouse traps baited with pieces of fish or roe.

The otter (*Lutra vulgaris* Erxl.) is a strong kind of marten with a flat head, a blunt snout, short round ears, and strong low legs, with webbed toes; the fur is exceedingly thick and smooth, dark brown on the top, and grayish-brown below. The body measures 80 to 100 centimeters [about 3 feet] in length, including a tail 40 centimeters [about 15 inches] long. The otter lives along rivers and lakes whose shores are covered with trees or bushes. It lives in burrows which it makes, or in old fox-holes, which have several entrances, one of which always opens under the water. It is a skilful swimmer and diver, lives on fish and crustaceans, and becomes very injurious by the circumstance that in

* "*Die Feinde der Teichwirtschaft.*" From *Die Teichwirtschaft*, Berlin, 1885. Translated from the German by HERMAN JACOBSON.

brooks and ponds where it finds plenty to eat it eats only a small piece of every fish it catches, then lets the fish go, and hunts for another. The presence of an otter can easily be ascertained by its tracks, which are recognizable by the distinct impression of the webbed feet, and by its excrements, generally deposited on flat stones, and containing scales, fish-bones, shells of crustaceans, and remnants of water-beetles. Its presence is also generally indicated by half-eaten fish lying on the shores.

Small ponds can easily be protected against otters by wire fences about 50 centimeters [20 inches] high and extending the same distance below the ground. As soon as there are indications of otters near large ponds, the whole neighborhood should be carefully searched, and when positive traces of otter have been found, steel-traps should be set, especially near the place where the otters regularly come ashore.

Among the birds the principal enemies of pond culture are the kingfisher, the heron, the duck, and the diver. Sea-eagles, gulls, and cormorants are found only near very large ponds or lakes; and we need not mention them here.

The kingfisher (*Alcedo ispida* L.) is a very beautiful bird with brilliant plumage, 16 or 17 centimeters long [about 6½ inches], with a long, straight, and sharply-pointed beak, and short tail. The upper part of the head and neck have a dark greenish-black color, with narrow, close sea-blue bands. The shoulders and wings are dark sea-green, the back has a beautiful blue color, and breast and belly are cinnamon-colored. From the root of the beak a cinnamon-colored, and below it a dark sea-blue streak extends below the eye as far as the shoulder. The throat has a yellowish-red color, the beak is black, and the root of the lower part of the beak and feet are bright red. The kingfisher is not gregarious, but lives alone near brooks, rivers, and ponds, where, changing about between some favorite places, it hides as much as possible, sitting on poles, stones, or overhanging branches close to the surface of the water, and watches for its prey. Frequently it may be seen darting over the water, swift as an arrow, and plunging into it head foremost, soon to return, carrying in its bill its prey. Its food consists principally of small fish and crustaceans, and also of large insects. According to Brehm, the kingfisher on the average devours every day ten or twelve small fish, each about as long as a man's finger. It therefore becomes very dangerous in trout brooks and ponds, especially as it is by no means so rare a bird as is generally supposed, but is found in considerable numbers near brooks containing fish. Max von dem Borne, of Berneuchen, has during fourteen years caught upward of seven hundred kingfishers near his ponds. As the kingfisher is in the habit of sitting on stones or stakes projecting a little above the surface of the water, it is easily caught in small steel-traps on whose prong a small piece of wood is placed, inviting it to rest. When caught, it flutters about and falls into the water, with the trap, where it is soon drowned.

The heron (*Ardea cinerea* L.) has a length of 1 meter [about 40 inches], and measures 170 centimeters [about 5½ feet] from tip to tip of its wings. It has an ashy-gray color, a white forehead, grayish neck, and dark sides. A streak running from the eye to the back of the neck, three long feathers on the back of the neck, a triple row of spots on the front part of the neck, and the long feathers of the wings, are black; the beak is straw-colored, and the legs brownish-black. It is found in the neighborhood of shallow waters, where it roosts and has its nest on high trees. They are frequently so numerous that hundreds of roosts are found close together. The heron is very shy and cautious, and fishes by daytime or during light nights standing or wading in the water. It prefers fish measuring about 20 centimeters [8 inches] in length.

As the herons are very injurious, the regulations prescribe that they must be killed and their roosts destroyed in the Government forests. But as in spite of these measures the number of herons is surprisingly large in many places, owners of ponds must endeavor to get rid of them as fast as possible by setting steel-traps baited with fish, or by laying fish poisoned with strychnine in places frequented by herons.

Ducks, both wild and tame, are very fond of fish spawn and young fry. They should, therefore, not be allowed on spawning and raising ponds, while in ponds where larger fish are kept they can do little or no harm.

Two varieties of the diver (the *Podiceps cristatus* L. and the *Podiceps minor* Lath.) are frequently found in considerable numbers on large ponds. The *Podiceps cristatus* is 95 centimeters [about 3 feet] long, of a shining blackish-brown color on the back and a pure white on the breast and belly. The sides are rust-colored with grayish spots; the cheeks, throat, and a large spot on the wing are white; the beak is pale red, the eye red, the foot horn-colored. Round the neck there is a collar of brown feathers, and on the head there is a top-knot in two parts, which can be raised. The *Podiceps minor* is only 25 centimeters [about 10 inches] long, of a shining blackish-brown color on the back, and below grayish with occasional dark spots. The throat is blackish; the head, sides, and front of the neck are brownish-red; the eye is reddish-brown; the beak yellowish-green at the root, and black at the point. Both varieties are nearly always in the water; they dive often and long, and fly but rarely. The *Podiceps cristatus* lives principally on small fish; while the *Podiceps minor*, according to some statements, prefers worms, snails, &c. It is very difficult to shoot these birds, because they are exceedingly cautious and are rapid divers; but it is easy to find their rudely constructed nests in reed thickets close to the surface of the water, and take their greenish eggs, which have a very fine flavor.

Among reptiles which live on fish, we may mention the swamp-turtle (*Emys europæa* L.), and the two varieties of snakes, the *Tropidonotus natrix* L. and the *Tropidonotus tessellatus* L., but they are so rare in our ponds that they cannot do much harm.

Among the *Amphibia* only the green water-frog (*Rana esculenta* L.) is dangerous to fish ponds. In some places it is found in very large numbers, and does a great deal of harm, not only by depriving the fish of their food in the way of insects, worms, &c., but also by devouring large quantities of small fish sporting about in the shallow water. In large ponds pike may be employed advantageously in destroying frogs; while the spawn of frogs and tadpoles is eagerly devoured by trout and carp. Spawning and raising ponds should, if possible, be protected against frogs by being fenced in with wire screens. Frogs which have hid, before the pond was fenced in, are easily caught in tubs placed in the ground near the edge of the pond; when jumping about they fall into these tubs, and are then thrown as food to the pike or trout. Frog spawn found in small ponds should be carefully removed with rakes, and thrown as food into ponds containing older fish.

Among the insects, two varieties of the water-beetle, the *Dytiscus marginalis* Sturm, and the *Acilius sulcatus* L., are particularly dangerous for fish, as both the beetles and their larvæ completely devour fish spawn and little fish measuring several inches in length, while they will eat deep holes into larger fish.

Another insect, the *Notonecta glauca* L., is found in some ponds in incredible quantities, and with its sharp prong, with which it also stings human beings so as to cause considerable pain, it kills a great many young fish, and sucks them. These hurtful insects may occasionally be caught in large quantities with muslin bag-nets. Pounded and kneaded into a dough with fine flour, they can very suitably be employed as fish-food. It is easy to destroy these insects on a large scale by scattering quicklime over the bottom of the pond after the water has been let off.

A large number of crustaceans are occasionally found on fish as parasites, without, however, inflicting any serious injury. There are only two varieties, which, when found in large numbers, do considerable damage in our ponds, namely, the *Lernæocera cyprinacea* L. and the *Argulus foliaceus* L.

When quite young, the *Lernæocera cyprinacea* resembles the sand-flea. After spawning the female changes, when it has firmly attached itself to the body of a fish, into a worm-shaped tube, 1 to 2 centimeters [about one-half inch] long, at the front part of which four horn-like excrescences develop, for adhering to the gills or penetrating between the scales of fish, and frequently they enter deep into the body of the fish; at the back part of the dirty-green body the numerous eggs are carried in two small, long bags, till they are ready to issue. *Lernæocera* is often found in enormous numbers on crucians, frequently also on carp, but rarely on other fish. By moving the hard excrescences referred to above, it causes gatherings in the skin of the fish, which gradually increase in size, soon assume a very disgusting appearance, and worry the fish very much. As it is impossible, in cases where the *Lernæocera*.

by its great numbers, does serious harm, to free each fish from these parasites, it is best to prevent their further increase by draining the infected ponds, and to sell the fish before the gatherings in their skin have become large, and to scatter a great quantity of lime over the bottom of the pond.

The *Argulus foliaceus* is round, pressed flat in the form of a shield, 4 to 6 millimeters [about $\frac{1}{5}$ inch] long, with a long sucking-prong, two strong sucking-disks with stems close to it, a pair of climbing legs with strong claws, and four pairs of webbed feet with stiff bristles. It has a dirty greenish-gray color, frequently swims about in the water in a lively manner, and occasionally attacks young fish in such numbers as to cover their entire surface, causing their death. The best means of destroying them is to scatter lime in the ponds.

Still greater than the number of crustaceans living on fish is the number of worms living on and in fish as parasites. But, as a general rule, they do not do much harm, with the exception of the *Piscicola geometra* L. This grows to the length of 2 or 3 centimeters [about 1 inch]. The broad sucking-disks, located at the front and back part of the body, protrude distinctly from the thread-shaped body, which is only 1 to 2 millimeters [about $\frac{1}{16}$ inch] broad, and of a greenish or yellowish-gray color with darker bands. By means of these sucking-disks this worm moves about in the manner of some caterpillars, while in the water it swims about rapidly with a meandering motion. In ponds which contain many of these worms the fish may be seen swimming about wildly, covered with hundreds of these worms all over their bodies, principally, however, round the fins, gills, eyes, and mouth. By rubbing against the bottom and the banks, the fish try to rid themselves of these parasites; they grow lean, and frequently perish in large numbers. The best means of destroying these worms is likewise to scatter lime in the pond. By putting the fish for a short time in a solution of water and 1 per cent of common salt, they can be freed from these parasites and again be placed in fresh water.

Some plants likewise occasionally become hurtful in ponds. Reeds, rushes, and other high aquatic plants should not be allowed to grow too luxuriantly in the ponds. Sometimes green algæ make their appearance in such enormous quantity as seriously to impede the movements of the young fish, by forming a net-work between other aquatic plants. Sometimes also these algæ cover a great portion of the surface of the pond with a yellowish-green slimy mass. They can easily be removed with a rake.

Lower forms of algæ, of the varieties *Nostochaceæ*, *Oscillariæ*, and *Chroococcaceæ*, occasionally produce by their astonishingly rapid growth the so-called "water-bloom" (*Wasserblüte*), and transform the water into a blue-green mass resembling oil. Sometimes this "water-bloom" causes the death of all the fish in a pond; in other cases only certain varieties die, and frequently the fish are not at all affected by it. So

far no experiments have been made with the view to ascertain which of the algæ forming the "water-bloom" exercise an injurious influence on fish. It is, therefore, very desirable that careful observation should be made in this respect.

The *Saprolegnieæ*, a low variety of fungus, which are injurious to fish eggs, are also frequently found in ponds on full-grown fish. They probably adhere only to sore places on the fish, and, spreading more and more, frequently cover large portions of the body of the fish with a thick slimy cover of a whitish color. This disease has been especially noticed in fish kept in small basins, and often destroys a great many fish; but even when in a state of freedom in open waters fish are frequently attacked by this epidemic, and in the English rivers the salmon frequently die of this disease by thousands. The purer and cooler the water is, and the more air it contains, the less will it favor the growth of these fungi. A healthy vegetation of green aquatic plants prevents their spreading all over a pond.

Fish which have been attacked by these fungi may be cured, unless very large portions of the body have become affected, by placing them for a short while in a solution of water and 1 per cent of salt, or by rubbing the sore places with a solution of water containing a higher percentage of salt.

As enemies of pond culture we may finally mention various diseases, which are known by a variety of names, but of whose causes and nature we are as yet almost entirely ignorant, and in respect to which we need much accurate and painstaking observation.

KÖNIGSBERG, GERMANY, *July*, 1885.

105.—FISHERY INDUSTRIES OF THE ISLAND OF HOKKAIDO, JAPAN.

By K. ITO.

INTRODUCTORY REMARKS.

The island of Hokkaido, in Japan, formerly known as Yesso, is situated immediately north of Niphon or Hondo, and separated from it by the Strait of Tsugaru. It lies between latitude 41° 21′ and 45° 30′ north, and has an area of 5,109 square ris (1 ri=2.5 miles). This island has remained, for a long time, as a wild territory, roamed over by Ainos, an aboriginal race; and it is not more than twenty years since the Japanese Government took up the effort for its colonization.

The only industry carried on by Japanese in this island previous to that time was fishing; and even in present days this constitutes one of the most important industries of the island. It is, however, to be remarked that the fisheries are confined to in-shore work, and the method pursued in curing fish caught is yet very primitive. Hitherto

no efforts which amount to anything have been made in the direction of propagation. Notwithstanding these circumstances the annual yield of the fisheries is $5,000,000 to $7,000,000; and, with the recent steps taken by the Government to introduce more enlightened and economical methods of carrying on the industries, and the enthusiastic efforts which the recently organized society of fishermen is making, it is to be hoped that the fisheries of the island will yield a much larger return in future.

STATUS OF SOME OF THE PRINCIPAL FISHERIES OF HOKKAIDO.

Herring fisheries.—Herring (*Clupea harengus* Linn.) are caught mostly along the western or Japan Sea coast of Hokkaido during their spawning season, which commences generally in the first part of April and continues until the latter part of June. Two kinds of net are used for their capture, namely, the moored trap-net and the gill-net. The larger part of the herring caught is worked up into scraps and oil, while the remainder is split and dried upon scaffoldings. Bones, gills, and milt left after the split herring is made, are separately dried and sold for manure; while roes are dried or pickled and used as an article of food. All products of the herring fisheries are used in the home market, except the oil, which is exported, when low prices prevail in the island, to a certain extent to the United States.

Fall-salmon or "sake" fisheries.—Fall salmon (*Oncorhynchus haberi* Hilgd.) or "sake," as it is called by the Japanese, ascend several streams in Hokkaido, after the middle of September, for the purpose of spawning. It is caught both in seas and rivers; in the former case traps and gill-nets being used, while in the latter drag-seines are employed. The salmon are mostly cured and sent to southern markets, although they are canned to some extent in the province of Nemuro.

Spring-salmon fisheries.—Spring salmon (*Oncorhynchus perryi* Hilgd.), known in the island as "masu," ascend the rivers in May. They are not so abundant as the fall salmon, but somewhat superior in flavor. The methods of capture and curing are materially the same as those for the fall species.

Cod fisheries.—Cod (*Gadus brandtii* Hilgd.) are caught mostly during winter and early spring with trawls. The fish of early in the season are slightly salted and sent to the southern market for immediate consumption; while those of the later season are split and "thorough cured," boned, and "hard dried." The liver is utilized for the manufacture of codliver oil, and the heads and bones are made into fertilizers.

"Iwashi" fisheries.—"Iwashi" (*Clupea melanosticta* Schleg.) is a small species of herring that approaches the eastern coast in rather small schools during summer for the purpose of seeking food. The school is more or less mixed with "seven-spots" (*Etrumeus micropus* Bleek.) and the young of spring herring (*C. harengus*). It is caught with drag-seines, and worked into oil and scraps.

Trepang fisheries.—Trepangs or sea-cucumbers (*Holothuria*) are collected with dredges upon the sandy bottom of the sea around the island. They are boiled in the decoction of the leaves of "yomogi" (a plant of the genus *Artemisia*) after the abdominal contents have been cleaned out, and are dried in a kind of kiln for exportation principally to the Chinese market.

Ear-shell fisheries.—The ear-shell or sea-ear (*Haliotis*) is a large gasteropod occurring only on the western coast. It is speared with a sort of trident from a dory in water from 2 to 4½ fathoms deep, the fishermen being enabled to discern the mollusk in these depths by the aid of an open box with a glass bottom, used on the same principle as a sponge-fisherman's water-glass. Suits of diving apparatus were formerly much used for this fishing; but this use was recently prohibited by legislation, on account of their devastating influence upon the fisheries. After the fresh product is separated from the shell, it is cooked, dried, and slightly smoked, for sending over to China.

Squid fisheries.—Squid is caught with hook and line, during the fall. It is split and dried, both for home consumption and for exportation to China.

"*Kombu*" *fisheries.*—"Kombu" is a species of algæ belonging to the genus *Laminaria*, growing upon submerged rocks in salt water. The best kind is collected mostly on the northeastern coast during the fall months. It is dried by spreading it upon a sandy beach, and afterward cut up into lengths of 4 feet, and bound into bundles weighing about 66 pounds each. It is inspected and branded before exporting to the markets of China.

Sea-otter fisheries.—The sea-otter is found about the Kurile Islands, where it is captured by means of guns and small bomb-lances, for its exceedingly rich furs. It is to be much regretted that this valuable fur-bearing mammal is rapidly diminishing in number, on account of the indiscriminate destruction of both young and old by those who come from different countries to hunt it.

Oyster fisheries.—The oyster occurs in the shape of small islands in some lagoons on the northeastern coast. It is cooked and dried with steam, and sent to China.

STATISTICS.

Number of persons, boats, seines, and nets engaged in the fisheries of Hokkaido in 1884.

	Hakodate district.	Sapporo district.	Nemuro district.	Total.
Fisheries proprietors	3,218	3,324	1,338	7,880
Employed hands	17,440	33,630	14,703	65,773
Boats	15,100	16,800	3,473	35,373
Seines	496	267	326	1,089
Trap-nets	935	1,828	335	3,098
Gill-nets	150,820	33,365	65	184,250
Miscellaneous nets	6,406	40	65	6,511

Value of the principal fishery products of Hokkaido in 1884.

Fishery.	Hakodate district.	Sapporo district.	Nemuro district.	Total.
	*Yens.**	*Yens.*	*Yens.*	*Yens.*
Herring	1,412,762	2,023,883	108,003	3,544,648
Fall salmon	31,989	221,993	281,874	535,856
Spring salmon	1,528	5,617	118,675	125,820
Cod	16,396	85,048	712	102,156
Iwashi	116,577	15,434	1,640	133,651
Trepang	5,661	23,210	14,623	43,494
Ear-shell	26,818	95,123		121,941
Squid	35,250	2,817		38,067
Kombu	49,993	189,811	164,440	404,244
Sea-otter			3,150	3,150
Oyster			13,413	13,413
Total	1,696,974	2,662,936	706,530	5,066,440

* One yen equals about 80 cents.

The total value of the yield for the year 1884 was unusually small, on account of a poor catch and low prices.

WASHINGTON, D. C., *December* 20, 1886.

106.—YOUNG SALMON IN NORTHERN NEW JERSEY.

By F. M. WARD.

[From a letter to Mr. Fred Mather.]

About May 20, 1885, nearly 100,000 fry of the Penobscot salmon (*Salmo salar*) were planted under the direction of the U. S. Fish Commission in the Paulinskill, Pequest, and Musconetcong Rivers, they being tributaries of the Delaware in Northern New Jersey. These fry were placed in the streams about 20 miles from where they emptied into the Delaware; and in September, 1885, some of the young fish were found in the Paulinskill, and in the small tributaries or spring runs near where they empty into the main stream.

In May, 1886, I learned that some salmon had been taken by a party while fishing for trout at a point about 5 miles below where they were placed the year before. The party that caught them thought at first that they were rainbow trout, but on examination I learned that they were young salmon from 4½ to 6 inches long. They were taken with common angle-worm bait, and seemed to be quite numerous at this point.

I saw them during the early part of last September in the same stream, and have no doubt that they have done equally well in the other two streams. There were about 40 taken at this point, and nearly all were returned to the water. I am satisfied from this experiment that planting the fry in the headwaters of the tributaries in natural trout water is the best way to stock the Delaware.

NEWTON, N. J., *November* 13, 1886.

107.—PRESENT CONDITION OF THE CALIFORNIA GRAY WHALE FISHERY.

By CHARLES H. TOWNSEND.

The California Gray Whale (*Rhachianectes glaucus* Cope) is the first species treated of in Capt. Charles M. Scammon's work on the Marine Mammals of the Northwestern Coast of North America, and his account testifies to its importance as an oil-producing cetacean in the estimation of the whalers of twenty years ago.

Although migrating to the arctic regions in summer, it was not usually molested in northern waters by civilized whalemen, to whom the baleen-yielding bowheads and right-whales were of more value; but when it had repaired to its winter breeding resorts in the lagoons and bays of Lower California, the whalemen, shut out from their arctic hunting-grounds, pursued it with great profit. From the fact of its being a species of rather limited range, unknown as far south as Panama, and unlike other whales, closely following the coast lines in its migrations, which subjected it to attacks from Eskimo and Indian whalers along shore as well as from the ships of white men, its numbers became much reduced, so that Captain Scammon, writing of it in 1874, predicted its speedy extinction.

The pursuit of the species in the lagoons of Lower California, where probably more than a score of vessels sought it annually, had already been abandoned as no longer profitable for ships, and numerous "shore stations" along the southern coast of Upper California had been established, from which small boats could be sent out to capture the gray whales during their annual migrations, which permitted of the business being continued so cheaply that it was still profitable, notwithstanding the reduced numbers of the whales.

For many years the gray whale has been undisturbed in its breeding haunts and appears to be in no danger of extinction as a species, notwithstanding the continuance of coast whaling. Its numbers certainly have not greatly increased, but recent experience with this whale leads me to the conclusion that the fear which has been expressed for the safety of the species is unfounded, and that it is in no immediate danger of extermination.

During several trips along the California coasts at various times from September, 1884, to January, 1886, I visited the shore whaling stations of Upper California as well as many of the lagoons of the Peninsula, and learned something of the business of coast whaling as it is carried on at the present time.

SHORE STATIONS.—Of the eleven whaling stations mentioned by Scammon as established along the coast ten or twelve years ago, only five remain—those at Monterey, San Simeon, San Luis Obispo, Point Conception, and San Diego.

Monterey.—The Monterey station is the oldest of these; and the charter of the Monterey Whaling Company, which I saw framed in the ancient stone building used as headquarters at that place, bore the date 1854. Gray whales then resorted to the shoal water along the north beach of Monterey Bay to roll in the sand as a relief from the barnacles and other parasites which infested them, and were easily secured, especially when half stranded at low tide; but the persistent persecution to which they were subjected drove them away, so that at the present time they must be sought far outside the bay. The seasons of 1885 and 1886 were especially dull at this station, owing in part to rough weather which prevented the boats from going out regularly, but chiefly to the wildness of the whales which were learning to shun the locality.

The "up season" at Monterey is now unproductive, as the whales keep well off shore when returning with their young. I was told at several stations that shore whaling began its decline with the general use of the bomb-gun and lance by inexperienced persons, so many animals having been wounded as to make them wary and in general more quiet in their movements, leading some of the whalers to a suspicion even of their "blowing" more cautiously.

The greater part of the oil yield at Monterey is derived from the humpback whales taken in summer, and it is probable that whaling would be abandoned at that station if the business depended upon the supply of gray whales. Monterey is in fact the only coast station where summer whaling can be carried on to any advantage. During the year 1862 the two companies then located there secured nearly 2,500 barrels of oil, the bulk of which was derived from the humpbacks, taken during the summer season, which lasts from September until December, the migration of the gray whales lasting from the latter date until February 15. So far as I observed, all the whalers there are Portuguese, whose manner of life is simple, and who appeared to make but little more than a plain living out of the business. There were eleven gray whales taken at Monterey in 1883, and twelve in 1884. Occasional finback and sulphur-bottom whales are secured there, so that with all the species obtainable there is still a fair yield of oil at that station.

San Simeon.—The San Simeon station was founded in 1864 by Joseph Clark, a Portuguese native of the Azores Islands, and has been kept in operation under his management ever since. Unlike Monterey, this station depends almost entirely for its business upon the gray whales, which pass southward with great regularity from December until February. The "up season," lasting until April, is also profitable at San Simeon, but the catch there consists chiefly of males, the females keeping farther off shore when passing northward with their young. During the last ten years Captain Clark has seen but one female accompanied by young in the vicinity of his station. At San Simeon, and all the whaling establishments situated south of it, females exceed the other sex in numbers during the "down run," and most of them contain well-

developed young. At this place and at San Luis Obispo, the nearest neighboring station, I saw four young whales lying on the beach, which had been taken from females killed in the vicinity during that season (December, 1885). Their average length was about 12 feet; the largest, which I sketched, being 17 feet long, and from an adult nearly 40 feet in length. They were probably within two weeks of the time of birth when the parent animals were killed. No use was made of these young whales, although they were coated with blubber 2 inches thick. Humpback whales are scarce at San Simeon, where they were once common.

San Luis Obispo.—The San Luis Obispo station has been in constant operation for many years. The season of 1885 was rather unprofitable there, several large whales which were killed having sunk too far off shore to be brought in, or the buoys, marking their position until they should float by decomposition, having been lost sight of. Three were secured late in the season.

Point Conception and San Diego.—The Point Conception and the San Diego stations, like the preceding, have been kept in profitable operation ever since their establishment, the former securing eleven and the latter eight gray whales during the past season. The San Pedro station is now abandoned, the force gathered there in 1884 now being employed at Point Conception.

PRESENT NUMBERS.—The following table, showing the numbers of gray whales taken on the southern coast of California during the past three seasons (167), is made from information furnished me by Mr. Clark and other whalers now in the business:

Stations.	1883–'84.	1884–'85.	1885–'86.
Monterey	11	12	5
San Simeon	11	15	14
San Luis Obispo	6	4	3
Point Conception	25	18	11
San Pedro (abandoned in 1884)	....	13	....
San Diego	5	6	8
Total	58	68	41

Stormy weather on the coast had the effect of lowering the annual catch in 1885–'86.

At the San Simeon station in December, 1885, I could see whales blowing almost every hour during the day. From the elevated "lookout," or observation station, on shore an extensive stretch of ocean could be examined with the telescope. During my stay, and for a short time afterward, covering a period of fully a month, Mr. Clark counted forty whales passing southward. Many of these were too far off shore to be pursued by the three boats that were daily cruising outside during the season, and a few may have been other species than gray whales, but counting the forty whales actually seen in December and doubling that number to include those that passed at night during the same period, we have eighty whales per month easily accounted for. Doubling

this number again to include those which pass within sight of the lookout station in January (for the "down season" lasts two months), we have one hundred and sixty whales as the number that may readily be seen at the present time from one point alone during the "down season." What proportion this number bears to the number passing off shore would be hard to say, but it is certainly less than half, since the whales near the coast are mostly females seeking bays and lagoons in which to bring forth their young, which would leave the males and young whales unaccounted for.

These safe and obviously low estimates, and the above table showing the actual catch during the past three seasons, afford a very fair showing for a species so scarce in 1880 that only one individual could be captured, and indicate a tendency towards its re-establishment while unmolested in its breeding resorts.

FOOD, YOUNG, PARASITES, AND HABITS.—The opinion of the men with whom I talked is that it does not feed to any great extent outside of its arctic habitat. It is certainly much thinner on the northward than on the southward run, a male that would yield 30 or more barrels of oil in the down season yielding less than 25 two months later. Whalers admit their ignorance of what constitutes the food of this animal, and can find nothing in its stomach during the breeding season.

The young *Rhachianectes* just before birth has a narrow, irregular, longitudinal ridge along the posterior part of the back, which I did not observe in the adult. It extends from about opposite the vent to the flukes and is interrupted in many places. This ridge probably corresponds to the series of transverse ridges along the back of the adult as described by Scammon. Although the young whales which I saw on the beach at San Simeon had been dead but a short time and were but slightly decomposed, the baleen was so loosely attached that it had slipped from its place in the jaws. It was not frayed and ragged on the inner surface as in that of the adult.

The adults usually have many barnacles deeply imbedded in the skin. The specimens I preserved have been identified by Mr. W. H. Dall as *Cryptolepas rhachianecti*. Numerous specimens of the whale-louse (*Cyamus*) were also seen.

While cruising among the lagoons of Lower California in 1884, searching for sea-elephants, I heard many stories told by the natives of the ferocity of the female gray whales when attacked in their breeding places—stories amply attested by the number of graves of ill-fated whalers one meets with all along these desolate shores. When her young had been killed, the female, actuated apparently by motives of revenge, attacked boat after boat, demolishing it and scattering and drowning its occupants. This dangerous character gained for the animal its common name of "devil fish," and that fatalities were of frequent occurrence may be emphasized by the statement that in the vicinity of the now deserted lagoons a leading feature in the landscape is the solitary grave with its conspicuous fence of weather-worn whale-ribs.

THE CHASE.—There are usually high observation stands at the shore stations of Upper California, from which a sharp lookout is kept. When the spouting of a whale is distinguished, the observer signals its position to the boats cruising off-shore, by means of a large flag, to which they reply by dipping the peak of the mainsail.

When near enough to the whale, a lance, with line attached, is fired into it from a heavy harpoon-gun mounted on the bow of the boat. It is finally killed by an explosive bomb-lance fired from a bomb-lance gun held to the shoulder, and is towed ashore after much hard rowing.

Mr. Clark, of San Simeon, recently took from a gray whale one of his own harpoons which he had fired into the animal two years before, the exposed portion of the instrument being rusted to the slimness of a pipe-stem, contrasting strongly with the bright and sound part protected by the flesh and blubber.

OTHER SPECIES.—The catch of other whales in 1884 and 1885 was as follows:

Stations.	Right-whale.	Hump-back.	Sulphur-bottom.
Monterey	....	17	7
San Simeon	3	....	....
Point Conception	1	....	....
San Diego	1	....	....

Occasional finback whales are taken at the coast stations, but their appearance is very irregular. Sperm-whales are of still rarer occurrence, but one was captured at Carmel Bay in 1875, which yielded 53 barrels of oil. Whale-oil prepared at the coast stations is worth about 25 cents per gallon.* At this low price, whaling for the gray whale must be carried on inexpensively from coast stations to support those engaged in it, and it is unlikely that a return to ship whaling in Lower California would be found profitable at the present time.

WASHINGTON, D. C., *November* 10, 1886.

EXPLANATION OF THE PLATES.

PLATE VI.—*Rhachianectes glaucus* Cope. California Gray Whale. Fœtus, 17 feet long, taken from an adult about 40 feet long, San Simeon Bay, California, December 25, 1885. Specimen inclined a little to the right side and slightly imbedded in the sand. (From a sketch by Charles H. Townsend.)

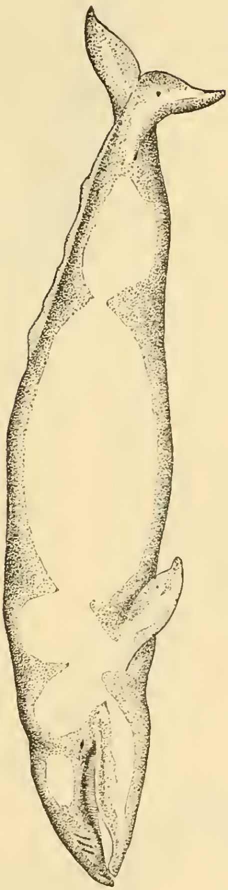
PLATE VII.—*Rhachianectes glaucus* Cope. California Gray Whale. Fœtus, 17 feet long. (From sketches by Charles H. Townsend.)

FIG. 1.—Head, from above. LL, lower lip. T, tongue.

FIG. 2.—Lower jaw, from below, showing the deep longitudinal furrows.

FIG. 3.—Flukes, from above.

* Arctic oil generally brings a few cents more in the market.



California Gray Whale, *Rhachianectes glaucus* Cope.

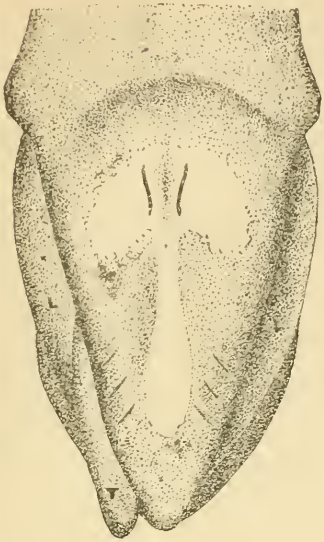


Fig. 1.

Fig. 2.

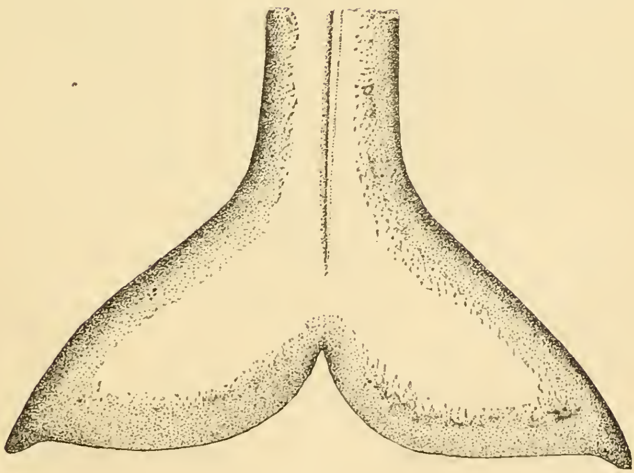


Fig. 3.

Head, lower jaw, and flukes of California Gray Whale, *Rhachianectes glaucus* Cope.

108.—SALMON IN THE HUDSON RIVER.

By A. N. CHENEY.

Ever since the beginning of artificial fish-culture there has been considerable discussion as to whether the Hudson ever was a natural salmon river, where the salmon regularly came from the sea for the purpose of spawning, and several attempts have been made to make its headwaters a spawning-ground for salmon at the present. When Henry Hudson, in 1609, sailed up the river he reported a "goodly store of salmon"; but with the exception of this statement, there is now no evidence that salmon ever ascended this river, and the few occasional fish that have been found were probably stragglers from the Connecticut. In fact, it must have been as impossible three centuries ago for salmon to reach the headwaters of the Hudson for the purpose of spawning as it is now—perhaps more so, owing to the absence of modern fishways. Cohoes Falls, near the mouth of the Mohawk, and Baker's Falls, at the great bend of the Hudson just below Glens Falls, must have kept the fish away from their suitable breeding-grounds. It is possible, of course, that salmon may have spawned in some of the small tributaries, or in the river itself below Baker's Falls; for it is stated on good authority that salmon spawn in the Restigouche River, of Canada, within a few miles of tide-water, and some instances are related of their spawning in brackish water at the head of the tide; but this is not at all likely, nor would such spawning suffice to keep the river stocked.

It is well known that salmon, in order to reach suitable spawning-grounds, will ascend falls of surprising height and surmount obstacles that would turn back any other fish. Some time ago the authorities in Norway caused some experiments to be made to ascertain the limit of the leaping powers of salmon. It was found that some fish jumped over a vertical barrier of 16 feet, while the average jump was 12 feet.

Between 1873 and 1876 the New York fish commission planted 156,000 California salmon fry (*Salmo quinnat*) in the headwaters of the Hudson, and nearly 100,000 on Long Island. Few, if any, of these fish were ever afterwards heard from; and it is supposed that the water of the rivers of the Atlantic coast south of 41 degrees of latitude is too warm for this species from the Pacific slope. In 1880 the State of Vermont made a small plant of Atlantic salmon fry (*Salmo salar*) in the Battenkill, which flows from Vermont into the Hudson north of Troy, and this planting may account for the salmon taken in the Hudson in 1884. Natural obstructions, however, prevent these salmon from returning to the place where they were planted.

It was determined by the U. S. Fish Commission a few years ago, when the obstacles that had previously stood in the way of the ascent

of fish were being overcome, to plant salmon fry in the headwaters, where they would find suitable and abundant food; and if they returned as mature fish through the waters of the lower part of the river the success of the experiment would be assured. Since 1882, accordingly, more than a million and a half of fry have been planted in the Hudson by the U. S. Fish Commission. As ordinarily these salmon go down stream to salt water at 2 years of age, and 2 years later return to spawn, it was expected that some would come back in 1886, as the first plant thus made was in 1882. That they did so is evidenced by the catch of 3 salmon, weighing from 10 to 13 pounds each, in the river below the Troy dam.*

A few days ago, during a freshet in the Hudson, two of the young salmon planted in the headwaters of the river were taken in the flume of a mill two miles above here, and replaced in the stream to go on their way to the sea. One weighed one-half and the other three-fourths of a pound, which shows very encouraging growth. The point where they were taken is three miles below Clendon Brook, which is the lowest tributary of the Hudson in which young salmon have been planted.

In October, 1885, at the request of Prof. S. F. Baird, I caught a few of the plant of 1884, then about 18 months old, and forwarded them to Washington. These young salmon were from 6 to 8 inches long, covered with fine silver scales and dotted with carmine and black. When they go to sea a few months later the carmine dots disappear, but the black spots remain and are found on the adult salmon. During the past summer I did not see in Clendon Brook (where they were planted) any that I considered of the plant of 1884; still, some may have been there, as all of one year's hatching do not go to sea at the same time. Some salmon grow much faster than others, and in one can of yearling fish (all hatched at the same time) I found that they ran in size from 2½ to about 6 inches. One of the salmon that were taken in 1885 contained ripe milt. In the summer of 1886 I reported that the plant of 1884 seemed to have gone to sea, and undoubtedly most of them had; but probably some of the slow growing fish of 1884 remained and could not be distinguished from those of 1885. In July last I took specimens of the plant of 1885, which were almost as large as the eighteen months' fish of the year before.

By these experiments Professor Baird has showed that salmon planted in the headwaters of the Hudson will endeavor to return there to spawn; and all that there seems to be lacking to make the Hudson a salmon river are means for the fish to get back to their spawning-grounds and laws for their protection. The obstacles are being overcome by means of fishways; but at present there is no protection for the Atlantic salmon in this State, as heretofore there have been no salmon to protect.

GLENS FALLS, N. Y., *December* 27, 1886.

---

*See notice of this in the Fish Commission Report for 1885, p. 110.

Vol. VI, No. 23. Washington, D. C. Dec. 31, 1886.

109.—BELOSTOMIDÆ AND SOME OTHER FISH-DESTROYING BUGS.

By GEORGE DIMMOCK.

[From Annual Report of the Fish and Game Commissioners of Massachusetts, 1886.]

Insects are generally considered to be beneficial to fishes by furnishing them one of the most unfailing sources of food. There are, however, a few insects which are injurious to fishes, thus making an exception to the rule. DeGeer[1] published a statement in 1774 that the larvæ of dragon-flies, or, as they are sometimes called, devil's-darning-needles (the *Libellulidæ* of naturalists), would seize and kill fishes, a statement confirmed by Dale[2] in 1832. Von Muetzschefahl[3] in 1778–'79 mentioned several aquatic insects which attacked the perch, among them two species of water-beetles (*Dytiscidæ*) and two species of water-bugs (*Notonecta glauca*, and *Nepa linearis*—now called *Ranatra linearis*). The destruction of young fishes by water-beetles has since been noted by Elles[4] in 1830, by Dale[5] in 1832, and by Riley[6] in 1885. In regard to the water-bugs, observations published within the past few years have not only confirmed the above-mentioned earlier statements, but other bugs have been discovered to attack fishes. Leidy,[7] as early as 1847, writes that species of *Belostoma* and *Perthostoma* (*Zaitha*) prey upon fishes. Glover,[8] in 1875, states that *Ranatra quadridenticulata* and *Belostoma americanum* feed on small fishes, and that *Nepa apiculata* probably, and *Notonecta insularis* possibly, do the same. Milner,[9] in 1876, writes that *Belostoma grande* captures and eats fishes. Miss Ormerod,[10] in 1878, describes how *Ranatra linearis* attacks fishes; the same year Peck[11] called attention to the destruction of the eggs of carp by the same insect. Turner,[12 13] the next year, mentions the killing of young sticklebacks in an aquarium by *Belostoma*. Leonard[14] notices the showing at the Edinburgh Fisheries Exhibition in 1882 of a preparation by Hugh D. McGovern, of Brooklyn, N. Y., of a year-old trout "surmounted by the fish-eating bug, *Belostoma grandis*," which was in the act of killing the fish by piercing its head; and Todd[15] the same year describes how a *Belostoma*, about three-quarters of an inch long, was seen to vanquish a fish three or four times its own length. Uhler,[16] in 1884, states that *Ranatra* destroys the eggs of fishes, and sometimes attacks the young fishes themselves and sucks their blood. Writing of *Belostoma grande*, the giant species of this genus that is found in tropical America, he states that "it is a formidable monster in the pools of

[1] Superior figures refer to the citations of literature at the end of this article.

Demerara, where it lurks on the bottom of the muddy pools which match its color, ever ready to grasp the unwary fish in the cruel embrace of its sharp hooked fore-legs, there to remain fixed until life becomes extinct with the outflow of its blood." This author adds: "Scarcely less rapacious are the species inhabiting the United States. One of these, *B. grisea*, is the facile master of the ponds and estuaries of the tidal creeks and rivers of the Atlantic States. Developing in the quiet pools, secreting itself beneath stones or rubbish, it watches the approach of a *Pomotis*, mud-minnow, frog, or other small-sized tenant of the water, when it darts with sudden rapidity upon its unprepared victim, grasps the creature with its strong, clasping fore-legs, plunges its deadly beak deep into the flesh, and proceeds with the utmost coolness to leisurely suck its blood. A copious supply of saliva is poured into the wound, and no doubt aids in producing the paralysis which so speedily follows its puncture in small creatures."

Of easily accessible articles in which the habits and fish-eating propensities of aquatic hemiptera are noticed, probably the most interesting, on account of its popular, simple style and because it deals with American insects, is the paper by Glover[8] in the Report of the U. S. Commissioner of Agriculture for the year 1875. This paper is entitled "Heteroptera, or Plant-Bugs," but deals with many bugs that either suck the juices from plants or animals, or that are entirely rapacious, as are most water-bugs, depending for their nutriment entirely on the blood of other animals.

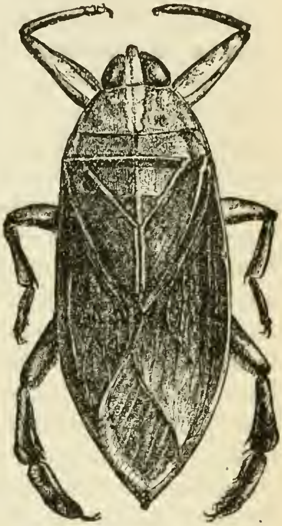
The rapid extension of fish-culture has called attention to the attacks made upon fishes by their enemies. It is quite likely that the requirements of fish-culture itself, such, for example, as associating together in the same pond large numbers of fishes of about the same size, has furnished conditions that have permitted the increase of the actual number of the hemiptera that prey upon them. The abundance of food for water-bugs in a pond stocked with small fishes only, and the absence of larger fishes to devour the bugs while the latter are still quite young, may both contribute to the welfare and increase of the bugs.

That the loss of fish due to these insects is considerable seems quite probable, because, notwithstanding their secluded habits, they are not rarely to be seen about ponds, sometimes even in the act of taking fishes. The following quotation from a letter from Mr. E. A. Brackett, of Winchester, Mass., chairman of the commissioners on inland fisheries for Massachusetts, under date of December 16, 1886, will illustrate this fact. He writes:

"In October last, while drawing off the carp pond, the water became very roily, and I noticed several young carp moving on the surface, sidewise, evidently propelled by some external force. With a dip-net I took these young fish out, and found that in every case they were firmly held by a water-bug. The fish were dead, and the bugs appar-

ently had been feeding on them. I had no means of determining how many of these bugs were in the pond."

The largest, and without doubt the most dangerous to fishes, of these water-bugs are those which belong to a family called by naturalists *Belostomidæ*. It is especially of these *Belostomidæ* that this paper treats. In the northeastern United States the common forms of these bugs belong to the genera *Zaitha*, *Belostoma*, and *Benacus*. The accompanying figure of one of the species of *Belostoma*, which genus in the tropics contains some veritable giants in the insect line, will give a good general idea of the form and appearance of these insects. The species figured, *B. grande*, is found in temperate and tropical parts of North America. The form of insects belonging to the genus *Belostoma* is elongated oval, and their considerably flattened form and large size serves to distinguish them from all the other before-mentioned water-bugs except those belonging to the genus *Nepa*, and from them they are easily distinguished by the fact that the body of *Nepa* terminates in a long tube formed by the apposition of two grooved appendages; through this tube the insect obtains air for breathing, while the species of *Belostoma* have no such tube. The form in *Zaitha* is like that of *Belostoma*, but the species are smaller. In *Benacus*, another closely allied genus, of which the sole species, *B. haldemanum*, is found in the United States, the femur of each fore-leg lacks the groove on its forward side, a groove which is present in the species of *Belostoma*, and which serves for the partial reception of the tibia when the fore-leg is folded up. The genera *Zaitha* and *Benacus* formerly were considered to be a part of the genus *Belostoma*.



Belostoma grande.—After Riley.

Insects of the family *Belostomidæ* are abundant in nearly all parts of the tropical and temperate zones of both hemispheres, except in Europe, where they are extremely rare; but, as a general rule, these insects are larger the warmer the climate in which they live. Individual specimens of *Belostoma grande* are sometimes found in tropical America which measure 4 inches in length, and *B. griseum*, which is found in the northern United States, attains a length of 3½ inches. The young of this species when only two days from the egg measured, according to Packard, a third of an inch in length.

The color of the species of *Belostomidæ* is brown, of a greater or less depth, or of a yellowish or a greenish shade. Partially covered with mud, they are quite difficult to discover. The sexes are not easy to distinguish from one another, except that females can at times be distinguished by the eggs which they carry.

These large insects are not only provided with powerful fore-legs which they use to seize their prey, and strong, somewhat oar-shaped hind-legs for swimming; but, when full-grown, they have strong wings and are capable of long-sustained flight. By their flights, which, as in most aquatic hemiptera, take place at night, these insects pass from one pond to another. This insures them a wide distribution, and makes their extermination a difficult matter. Living, as they often do, in pools which dry out at certain seasons of the year, this provision for flight is a necessity of their existence. That these flights are often long and high is proved by the fact that the bugs have been found in the midst of large cities, far from any pond or pool, upon the roofs of three and four story blocks. It is probable that they are found in these situations from having been attracted to the reflecting surfaces of sky-lights, for it is well-known that water-beetles, with their imperfect sight, mistake large expanses of glass, such as are presented by green-houses, for sheets of water. Especially attractive, however, to these large water-bugs are electric lights, and notices have appeared in the daily press of the swarming of these, as well as of other insects, about the electric lights of cities. In flight, as Mr. Brackett states in the letter from which I have already quoted, the species of *Belostomidæ* which he observed can arise directly from the surface of the water.

These insects differ, according to the species, as to their mode of egg-laying. Some, like the common *Zaitha fluminea* of our northern waters, lay their eggs on their own backs. In my collection I have a specimen of this species which has her back almost entirely covered by a nicely-arranged layer of elongated-oval, dark-brown eggs, which number over a hundred and seventy-five. These eggs are set nicely upon one end, and placed in transverse rows, by means of a long protrusile tube, or ovipositor, which the insect can extend far over her own back. This mode of oviposition insures the safety of the eggs until the young are hatched. The eggs are fastened to the back of the mother by a very thin layer of a waterproof gum secreted by the insect. The entire layer of eggs is apt to split from the insects when they are dried, and consequently is rarely seen in collections of insects. The young bug hatches from its egg by means of cutting out a round lid from the top of the egg, and at about the time when the young brood begins to hatch the mother sheds the entire layer of eggs from her back, something as she would molt her skin during growth. It is probable that all the species of *Zaitha* carry their eggs about with them, while, on the other hand, some, if not all, the species of *Belostoma* deposit their eggs in masses, under boards and logs, near the margins of the pools which they inhabit.

The young, upon hatching from the eggs, go immediately on their predaceous course, often feeding at first on young snails. As is true of most hemiptera—the bugs properly speaking—the young differ little from the adults except in the absence of wings in the former. In *Belos-*

toma the young, however, have two claws on the tarsi of the fore-legs, while as adults they have only one tarsal claw in the same place. It is not certainly known, but it is likely that these insects reach their full growth in a year.

In seizing upon fishes or other small animals these insects grasp their prey with their fore-feet, holding it firmly in their claws, then piercing it with their beak or proboscis; for they only suck blood, not being able, as is the case with water-beetles, to eat the whole animal. The proboscis consists of stout horny setæ or bristles which fit closely together to form a fine sucking-tube, while the exhaustion is performed by means of a muscular, extensible pharynx, or throat. As is probably the case with all carnivorous hemiptera, only living prey is acceptable to these insects. The predaceous water-bugs are said to destroy the eggs of fishes, although further confirmation of this statement is desirable.

When the water bugs attack other animals it is noticeable that the prey dies much quicker than it would normally do from simply the loss of blood consequent upon the sucking of the bug, so it is generally supposed that these insects inject a poisonous secretion through their proboscis into the wound they make. Most of these insects inflict quite severe stings, in self-defense, if they are handled too freely, using the proboscis for this purpose. Leidy[7] describes the salivary glands of *Belostoma*, which are well developed, and it is undoubtedly the secretion of these glands that poisons the prey when it is pierced by the proboscis.

As will be seen from the preceding part of this paper, the destruction of the bugs that attack fishes is not an easy matter. The water-beetles can be trapped by the use of decaying animal matter, of which they are very fond. I have seen a dead rat in a small pond surrounded by a great number of these beetles (*Dytiscidæ*), and they prefer such food to living food. On the other hand, the water-bugs will take only living food, so that their entrapping by any bait would be difficult.

The use of poison for aquatic hemiptera seems also impracticable. As hemiptera eat only liquid food which they can suck up through the fine tube of their proboscis, poison that would have any effect upon them must be a liquid, a very finely-divided substance held in suspension in a liquid, a corrosive substance that will directly attack the surface of the bug, or some substance that gives off poisonous vapors. The above remark applies to all hemiptera, but the destruction of aquatic hemiptera is still more difficult. In their case no liquid poison can be applied, because the bugs would not eat it, and because its mixture with water would endanger the fish that it was sought to protect. For like reasons no corrosive substance or poisonous vapor is applicable. Water-bugs are so much hardier than fish that nothing dissolved in the water would injure them that would not prove dangerous for the fish

Searching for the eggs of the water-bugs might prove useful on a small scale, but would, of course, be useless for the numerous species of *Zaitha*, which lay their eggs on their own backs. If the collection of the eggs of those species which lay their eggs in masses was attempted, it might be possible to cause the insects to lay their eggs under boards placed in favorable localities in shallow water, and the eggs could be taken from beneath the boards every few days and destroyed. This mode of destroying the eggs is offered as a suggestion, not having had, to my knowledge, any trial.

Collecting the adult bugs with nets would somewhat lessen their numbers, but would prove of value only in small ponds, and even these ponds might become restocked with bugs in a single night. Capturing migratory insects has little value in lessening their depredations, except where the capturing can be done under very favorable circumstances and over large areas of country.

Keeping fish ponds clean will certainly be of use in restraining the depredations of water-bugs, as they prefer to live in mud and rubbish rather than in clear water.

The introduction of some insectivorous fish that will not eat the young fishes would be the most feasible way of ridding a pond of these insect pests, but my knowledge of the habits of fishes is not sufficient for me to state whether any such fish is available for use in our fresh-water ponds. A careful study of what is known about the food of our fishes might reveal some species that would keep water-bugs exterminated from any pond into which it was introduced. Ducks are known by insect-collectors to nearly exterminate the insects from some of the ponds which were the best for the collection of water-beetles before the ducks had access to them. Uhler mentions that, in the Harris collection of insects, there is a specimen of a water-bug (*Zaitha fluminea*) bearing the label, "Found in great numbers in the stomach of a duck." But ducks might eat some of the young fishes, thus proving their uselessness for the purpose intended. Among the enemies of the *Belostomidæ* may be mentioned little red mites, which are often seen attached to the joints of the bugs; but these parasites probably cause their hosts but little trouble, and could not be used in any way as a means of their destruction.

The mode of destroying the water-bugs that seems to me to be the most feasible is by the employment of the electric light, and even this method, which would only pay on a large scale, might fail to destroy a sufficient number of the bugs to be of practical value. Since the introduction of the electric light as a means of lighting streets, several notices have been published to the effect that, among other insects which are attracted to the light and sometimes swarm about in numbers, are the aquatic hemiptera. Striking against the glass which surrounds the light they fall to the ground. Collectors of insects have taken advantage of

this habit of the bugs, and by waiting beneath the electric lights have enriched their collections by capturing the fallen insects. The more brilliant the light the more insects are attracted to it, and on this account the electric light has proved much more favorable for collectors than gas-lights were. If the number of bugs attracted to the electric light were found to be sufficient to make that a valuable means for destroying them, it would be easy to contrive a trap that would retain the insects after they had fallen beneath the light. Traps constructed on a similar principle have been used by insect collectors for a long time.

It is quite possible that an illuminated trap beneath the surface of the water would attract many more of the *Belostomidæ* than does a light above the surface, for these insects do not often leave the water, apparently, except when they quit it for the purpose of migration.

In conclusion, it may be said that any practical modes of combating such insect pests as *Belostoma* are as yet undiscovered.

LITERATURE.

[1] de GEER, C. Mém. pour servir à l'hist. des ins., 1771, v. 1.

[2] D [ALE, J. C.] Brief notices of the habits and transformations of the dragon-fly; * * * (Mag. nat. hist., 1832, s. 1, v. 5, p. 517-520, fig. 98.)

[3] von MUETZSCHEFAHL. Nachricht von einigen wasser-inseeten an der bartsch, nach welchen sich die fischer bey ihren winterfischereyen richten. (Oekon. nachr. d. Gesells. in Schlesien, 1778, v. 6, p. 393-394; 1779, v. 7, p. 2–5.)

[4] ELLES, J. The water beetle. (Mag. nat. hist., 1830, s. 1, v. 3, p. 148–149.)

[5] DALE, J. C. Small fishes are destroyed by other insects, besides the larvæ of the dragon-flies. (Mag. nat. hist., 1832, s. 1, v. 5, p. 668.)

[6] RILEY, C. V. Water-beetles destroying carp. (Bull. U. S. Fish Comm., 1885, v. 5, p. 311.)

[7] LEIDY, J. Hist. and anatomy of the hemipterous genus *Belostoma*. (Journ. Acad. nat. sci., Phil., 1847, v. 1, p. 57–67, pl. 10.)

[8] GLOVER, T. Report of the entomologist. Heteroptera, or plant-bugs. (Rept. U. S. Comm. Agric., 1875, p. 114–136, 63 fig.)

[9] MILNER, J. W. Invertebrates which prey upon fishes, reptiles, and amphibia. (Field and forest, July, 1876, v. 2, p. 4–6.)

[10] ORMEROD, *Miss* E. A. *Ranatra linearis*. (Entomologist, 1878, v. 11, p. 119–120.)

[11] [PECK.] *Ranatra linearis* attacking carp eggs. (Entomologist, 1878, v. 11, p. 95.)

[12] TURNER, H. W. The *Belostoma* piscivorous. (Amer. nat., 1879, v. 13, p. 585.)

[13] TURNER, H. W. *Belostoma* piscivorous. (Amer. nat., 1879, v. 13, p. 710–711.)

[14] LEONARD, J. A. Report on the Edinburgh fisheries exhibition. (Bull. U. S. Fish Comm., 1882, v. 2, p. 80–82.)

[15] TODD, J. E. A small *Belostoma* captures a fish. (Amer. nat., 1883, v. 17, p. 548–549.)

[16] UHLER, P. R. Hemiptera. (Standard nat. hist., 1884, v. 2, p. 204–293, fig. 286–340.)

CAMBRIDGE, MASS., *December* 20, 1886.

110.—SHRINKAGE OF WHITEFISH EGGS DURING TRANSPORTATION ON TRAYS.

By W. F. PAGE.

On December 8, 1886, a case of whitefish eggs was received at Central Station, U. S. Fish Commission, Washington, D. C., from F. N. Clark, Northville, Mich. The package was said to contain 100,000 eggs. When the package was opened and the eggs were transferred to a McDonald hatching-jar (new style) at 4 p. m. on the same day, the eggs were found to measure but 64,000. They were again carefully remeasured at 9 a. m. on December 10, and found to be 72,000, an increase of 12½ per cent.

When the eggs were received they did not present any appearance of shriveling or other distortion from normal shape and size; yet it is evident that a shrinkage of bulk must have occurred between the time they left Northville and arrived in Washington, and further, that they regained a part at least of their former bulk. On January 8, 1887, thirty days after the second measurement, they were again measured and, although a small number of dead eggs had been removed from the jar the number was still found to be 72,000.

If, as it appears, a shrinkage of 12½ per cent occurs in the comparatively short shipment from Northville to Washington, it is fair to suppose that in the longer transoceanic shipments the shrinkage would amount to much more.

On January 22 a consignment of eggs which had been out of water about 28 hours arrived at Central Station, and were at once placed in circulation in 12 jars of water at 37° F. Measurements of the quantity were made on the basis of 36,000 eggs to the quart after introduction into the jars and 42 hours later, with the following result:

Number of jar.	Number of eggs as indicated by first measurement.	Number of eggs as indicated by second measurement.
2	153, 000	165, 000
3	153, 000	158, 000
4	133, 000	150, 000
5	153, 000	158, 000
6	145, 000	162, 000
7	153, 000	180, 000
8	125, 000	144, 000
10	135, 000	153, 000
11	135, 000	158, 000
12	135, 000	155, 000
13	140, 000	160, 000
14	140, 000	157, 000
Total in 12 jars.	1, 700, 000	1, 900, 000

The increase in bulk due to returning the eggs to water amounts to $11\frac{13}{17}$ per cent.

WASHINGTON, D. C., *January* 27, 1887.

111.—REPORT OF OPERATIONS AT THE SHAD-HATCHING STATION ON BATTERY ISLAND, NEAR HAVRE DE GRACE, MD., DURING THE SEASON OF 1886.

By L. R. GRABILL,

Superintendent of Battery Station.

[Abstract.]

The first run of shad was perceived on April 18, and 35 ripe shad were taken on April 19. This run continued for a week, and was larger in number than had been known for 20 years. Both shad and herring came in enormous quantities. It was impossible to obtain the catch of shad at the seines during this run. The catch of Mr. Osmond's seine in shad for one day alone was more than 5,000.

The collection of spawn for the station was done by men and boys hired temporarily for the purpose. As many as 40 men and boys in addition to the station's ordinary force were employed. These were paid monthly wages, each being allowed $10 a month for subsistence. It was endeavored to station men permanently at all the seines, and to attend to as many gill-nets as possible. The men were graded as first and second class spawn-takers, and apprentices. Besides these, boys were used merely as oarsmen.

Experience shows, however, that it will be better in the future to employ 3 men to every boat, 2 of whom are apprentices; these 2 to take nightly turns at receiving instruction. Boys, unless quite large and strong, cannot care for boats in a squall. Large as was the collecting force it could not attend to more than one-half of the gilling boats on nights when all of the fishermen were out. As a rule it was found more profitable to attend gill-nets than seines.

Collection was continued from April 19 to June 10, the total number of eggs collected being 60,766,000. Of this number there were received from the steamer Fish Hawk 2,099,000, and from the steamer Lookout 2,433,000, the total received from other sources thus being 4,532,000.

The Commission's gill-nets were put in use during the latter part of the season, there being no scarcity of male fish during the first part. Notwithstanding the smaller mesh of the net, it was not noticed that there was a large difference from other nets in the proportion of male fish caught. The largest roe fish seen during the season was caught in one of the Commission's small-mesh gill-nets. On a few occasions these nets served a good purpose in supplying male fish for impregnating eggs, but they did not supply these male fish nearly so often as they were supplied from ordinary nets near at hand. The Commission's gill-nets, being fished by expert fishermen, caught about as many fish, both male and female, as most of the gill-nets fishing in the same locality.

At the beginning of the season the hatching department was not prepared to do the work that was forced upon it by the early and immense

run of shad. The connections for the hatching apparatus and for the water supply were inadequate to the demand, and the supply of hatching apparatus on hand was insufficient. To increase the hatching room an addition, covered with canvas, was made, accommodating 2 tables additional with 50 McDonald jars. The store-room used for the seine was furnished with sky-lights, and 28 hatching cones were placed in it, and about 30 cones in all conditions of repair were hastily fitted up outside of all shelter. Notwithstanding the increase thus made, the cones and jars constantly carried twice as many eggs as they should have done, and much loss was the result. But by far the greater loss was caused by being obliged to allow eggs brought in to stand in buckets, &c., until room could be made for them. In many cases eggs nearly hatched were compelled to be placed in the river to make room for new ones. About 170 McDonald jars and 58 cones were in constant use, supplemented by wire-gauze cylinders, buckets, pans, and all kinds of arrangements for hatching.

Three experts were employed during most of the season in the hatching-house. Three apprentices were also employed most of the time as assistants. These men received and cared for all eggs, cared for the fish when hatched, filled the cans for shipment, and loaded them in the launch or scow.

Notwithstanding the losses, the number of shad fry hatched was 45,231,000. These numbers are based on the measurement of the perfectly cleaned eggs in the jars just before hatching in every case, and are as nearly accurate as these figures can be made. It is believed that this is rather under than over the actual result. The percentage of hatching during the season was 74.4. The total number of fry shipped and receipted for by messengers was 43,776,000. The total loss of fish was 1,455,000. Three tables are appended to this report, which give details concerning the collection of the eggs, the shipments of the fry, and meteorological observations during most of the season.

The collecting force was entirely disbanded after June 10, when gilling is no longer permitted by Maryland laws. On June 13 all the eggs on hand had hatched, and the hatching department was then closed. But few eggs, however, were taken after June 1, the date on which the greater part of the force was discharged. After the close of the hatching season the time of the small number remaining was given to storing the equipment, and in work upon a drive-well, which was begun with the hope of finding an artesian water supply. This well was carried to a depth of about 150 feet by July 1.

There is little doubt but that the area of 4 or 5 square miles immediately surrounding Battery Station is as large as any, if not the largest, spawning ground for shad on the coast. The station is well located for reaching every part of this ground. The possibilities of the station are almost unlimited. Fishermen and fishing boats cover the bay during the season, and every ripe egg taken in fish in the nets would be

lost if it was not taken by the collectors of the station, impregnated, and hatched. One need only to see the bay studded with the lights of the fishing boats on a night in May to convince him that but for the Commission's work very few fish could come from eggs naturally deposited. But, large as was the Commission's force last year, I am satisfied that not over one-half of the ripe fish taken in the bay by fishermen were stripped by its collectors, as they could not possibly attend to all.

It is fairly demonstrated by this season's work that collecting from gillers produces a better result than hauling the Commission's seine. Two or 3 men can secure as many ripe fish from gillers in a day as 30 men would secure if employed in hauling the seine. Moreover, hauling the seine by the employees of the station necessarily involves the Fish Commission in the care and disposal of the fish taken, while it seems to antagonize the fishermen, and is an unnecessary cost. With a good run of fish in the coming year, if the collecting force is doubled and their work thoroughly systematized, perhaps double the number of eggs secured last season can be obtained during 1887. The collection of eggs in 1886 was stimulated also by giving small rewards to those gathering the greatest amount of good spawn.

PENNING SHAD.—Out of a large number of shad full of roe, but not ripe at the time of introduction, which were placed in the pool and kept for a space of time ranging from a few days to 2 weeks, not one ever produced eggs that would hatch, though apparently ripe when stripped. It would seem that possibly the fright at being taken in the net, or of confinement in the pool, prevents the eggs from further development. All of the fish placed in the pool become more or less diseased after a short time, which may be due partly to the muddy bottom. This interesting experiment has hitherto met with such small success as to warrant its being dropped hereafter.

HERRING.—Herring were taken continually and sometimes in such quantities as to retard the hauling of the seines. No account was kept of them, as they were considered valueless in most cases, and they were shoveled back dead into the river or allowed to escape through the large meshes before completely hauling in the seine.

ROCKFISH OR STRIPED BASS.—Experiments were made in hatching the eggs of the rockfish, the greatest success being obtained by swinging a cylinder with gauze ends in a sluice-way through which a current, caused by the tide, constantly flowed. It appears, however, that even with very fine gauze the eggs in a certain state are forced through. Owing to want of time, caused by pressure of other matters, sufficient attention could not be devoted to these experiments, and most of the eggs taken were lost. In all, 600,000 rockfish eggs were taken, and 75,000 fry were shipped to Lake Ontario, near Oswego, N. Y.*

WASHINGTON, D. C., *December* 20, 1886.

---

* For notice of their successful planting, see F. C. Bulletin for 1886, p. 137.

TABLE I.—*Record of the shad-hatching operations conducted at Battery Station, Maryland, from April 19 to June 13, 1886, under direction of L. R. Grabill, superintendent.*

Date.		Fish obtained from—		Taken by haul-seines.†		Taken by gill-nets.	Ripe shad.		Eggs obtained.	Loss.		Fish hatched.‡	Fish deposited in local waters.	Fish deposited in other waters.
Day of week.	Day of month.	Length of haul-seines visited.*	Length of gill-nets visited.	Shad.	Rockfish.	Shad.	Males.	Females.		Eggs.	Fish.			
		Fathoms.	*Fathoms.*		*Pounds.*									
Monday	Apr. 19	2,500	2,190	3,587		816	20	39	1,782,000	[1]170,000				
Tuesday	Apr. 20	2,200	1,955	2,188		620	35	71	3,112,000					
Wednesday	Apr. 21	2,700	3,200	2,600		1,389	45	91	3,899,000					
Thursday	Apr. 22	2,700	6,425	1,700		2,009	90	145	4,859,000					
Friday	Apr. 23	2,500	4,582	1,500	400	1,144	56	119	3,780,000	[2]763,000				
Saturday	Apr. 24	1,800	1,625	1,000		244	10	17	467,000	[3]375,000				
Sunday	Apr. 25		4,150			767	20	36	785,000	[4]122,000		1,327,000	25,000	
Monday	Apr. 26	800	5,725	484		521	20	28	1,228,000	[5]389,000		2,119,000	1,421,000	
Tuesday	Apr. 27	800	5,420	168		588	35	50	1,475,000			2,431,000	2,431,000	(6)
Wednesday	Apr. 28	1,500	5,505	191	300	693	30	47	1,541,000			3,064,000	860,000	[7]1,500,000
Thursday	Apr. 29	1,900	4,870	1,056		306	20	30	1,040,000		[8]169,000	1,000,000	1,055,000	
Friday	Apr. 30	2,000	5,430	1,199	500	405	20	33	1,013,000		[9]277,000	1,177,000	50,000	[10]1,430,000
Saturday	May 1	1,500	2,375	175		324		22	1,179,000			200,000		1,200,000
Sunday	May 2		4,150			398		19	[11]3,070,000	[12]50,000	[12]50,000	771,000		
Monday	May 3	1,700	11,390	2,437	800	2,314		123	3,594,000			1,500,000 } [13]1,952,000 }	[13]1,952,000	1,621,000
Tuesday	May 4	2,300	8,625	1,315	500	2,311		210	5,648,000		20,000	1,000,000		
Wednesday	May 5	2,600	8,550	1,850		1,954		110	4,046,000		10,000	1,814,000	804,000	1,500,000
Thursday	May 6	1,800	9,510	1,325	300	894		108	3,295,000		10,000	1,103,000	503,000	
Friday	May 7	1,800	2,700	450	200	104		31	944,000			689,000	742,000	
Saturday	May 8											1,000,000		500,000
Sunday	May 9	1,100	2,250	200		60		4	112,000		10,000	2,156,000		[14]1,650,000
Monday	May 10	2,600	1,950	334	200	40		3	[15]32,000	66,000	50,000	2,000,000		2,000,000
Tuesday	May 11	2,600	4,200	413	600	41		4	[16]1,127,000		40,000	3,000,000		2,400,000
Wednesday	May 12	1,800	4,550	135	50	99		5	193,000		30,000	1,593,000	1,500,000	850,000
Thursday	May 13	2,500	1,525	243	100	21		1	248,000		6,000	1,300,000		1,900,000
Friday	May 14	2,800	9,100	333	150	238		26	828,000		20,000	1,700,000		[17]2,350,000
Saturday	May 15	1,600	600	230	100	12		6	265,000	33,000		1,370,000	370,000	
Sunday	May 16										20,000	300,000		450,000
Monday	May 17	2,800	5,850	300	250	148		10	305,000	50,000	20,000	414,000		300,000
Tuesday	May 18	3,600	7,150	502	75	152		43	1,469,000	138,000	30,000	130,000		1,050,000
Wednesday	May 19	2,900	11,785	400	100	377		61	1,710,000	482,000	30,000			990,000
Thursday	May 20	1,100	8,425			240		50	1,544,000	305,000		200,000		
Friday	May 21	2,300	6,400	40	25	198		41	1,317,000	269,000	10,000	300,000		300,000
Saturday	May 22	1,100	4,035	266		211		40	1,070,000	196,000		700,000		
Sunday	May 23		1,650			46		9	265,000	37,000		245,000		

Monday	May 24	1,300	3,150	50	[18]150	211	...	25	622,000	123,000	30,000	1,500,000	...	895,000
Tuesday	May 25	...	750	...	...	24	...	4	60,000	45,000	...	1,255,000	...	...
Wednesday	May 26	...	600	...	...	20	...	...	...	...	60,000	1,000,000	759,000	2,336,000
Thursday	May 27	...	600	...	...	4	...	...	...	...	30,000	1,013,000	...	977,000
Friday	May 28	1,300	780	60	[19]150	16	...	4	158,000	34,000	20,000	1,000,000	...	500,000
Saturday	May 29	1,300	1,100	23	[19]100	...	...	...	...	...	30,000	...	...	1,100,000
Sunday	May 30	...	...	...	...	35	...	5	112,000	21,000	10,000	200,000	...	200,000
Monday	May 31	...	1,350	...	...	134	...	22	508,000	96,000	20,000	499,000	...	550,000
Tuesday	June 1	...	1,750	...	...	99	...	14	259,000	...	20,000	45,000	...	500,000
Wednesday	June 2	...	1,100	...	...	61	...	22	545,000	[20]134,000	...	...	100,000	...
Thursday	June 3	...	1,150	...	...	31	...	8	189,000	...	...	124,000	...	...
Friday	June 4	...	1,250	...	...	18	...	6	64,000	...	...	100,000	...	...
Saturday	June 5	...	700	...	...	28	...	3	82,000	...	10,000	177,000	[21]228,000	...
Sunday	June 6	...	200	...	...	5	...	3	78,000	...	...	416,000	...	...
Monday	June 7	...	1,100	...	...	123	...	19	476,000	...	20,000	312,000	[21]429,000	...
Tuesday	June 8	...	1,750	...	...	111	...	16	371,000	...	...	151,000	...	...
Wednesday	June 9	...	400	...	...	3	...	...	...	...	20,000	147,000	[21]472,000	...
Thursday	June 10	...	200	...	...	2	...	...	...	...	10,000	78,000	[21]298,000	...
Friday	June 11	...	...	...	...	...	...	...	...	...	...	403,000	...	...
Saturday	June 12	...	...	...	...	...	...	...	...	...	20,000	256,000	[21]481,000	...
Sunday	June 13	...	...	...	...	...	...	...	...	...	10,000	...	[21]256,000	...
		...	...	...	...	...	...	...	...	...	[22]343,000	...	...	...
Total	...	65,800	185,777	26,754	5,050	20,611	401	1,783	60,766,000	3,888,000	1,455,000	45,231,000	14,727,000	29,049,000

* Records for the haul-seines are very incomplete. No hauling of seines is allowed by Maryland law after June 1.

† Herring were taken in great numbers, but no account of them was kept.

‡ 74.4 per cent of all eggs taken were hatched.

[1] Kept too long in buckets.

[2] No room for them in hatching-house.

[3] Kept on shore all night.

[4] Not good.

[5] Put on trays in refrigerator because hatching-house was full.

[6] Fifty thousand eggs sent to H. C. Mercer, to be put into Danube River.

[7] Sent to car No. 1.

[8] Eighty thousand hatched from 200,000 eggs in refrigerator, and died in a few hours; 89,000 lost by overflow of aquariums.

[9] Lost by overflow of aquariums.

[10] Shipped by car No. 1.

[11] From steamer Fish Hawk, 2,099,000.

[12] On account of lack of water.

[13] Eggs nearly hatched and put overboard to make room.

[14] Also 585,000 eggs in best condition received this day.

[15] Also received 600,000 rockfish eggs.

[16] From steamer Lookout, 992,000.

[17] Also shipped 75,000 rockfish to Oswego, N. Y.

[18] Two hundred pounds of other fish taken.

[19] Five hundred pounds of other fish taken.

[20] Over mature

[21] Deposited in Susquehanna River, for want of means of removal.

[22] Not assignable to particular date or dates.

TABLE II.—*Record of meteorological observations made at Battery Station, Maryland, from May 1 to June 12, 1886, by William P. Sauerhoff and D. W. Kenly.*

Date.	Temperature of air.			Temperature of surface water.			Temperature of bottom.			Direction of wind.			Intensity of wind.			Condition of sky.			Condition of water.	State of tide.		
	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.		7 a. m.	4 p. m.	11 p. m.
	°	°	°	°	°	°	°	°	°													
May 1	56	59	59	61	60	59	61	60	59	NE.	NE.	N.	Strong	Strong	Fresh	Cloudy	Cloudy	Cloudy	Clear	High	Ebb	Ebb.
2[1]	57	66	61	57	62	60	57	62	60	N.	E.	SE.	Fresh	Light	Light	do	do	do	do	Flood	Flood	Do.
3	60	66	66	60	64	64	60	64	64	SW.	SW.	SW.	Light	do	do	Clear	Clear	Clear	do	do	do	Do.
4	67	67	65	64	64	64	64	64	64	SW.	SW.	SW.	do	do	do	do	do	do	do	do	do	Do.
5	62	70	67	64	65	64	64	65	64	S.	NW.	W.	do	Fresh	do	do	do	Cloudy	Muddy	do	Ebb	Do.
6[2]	65	68	64	64	65	64	64	65	64	SE.	SW.	S.	Fresh	Light	do	Cloudy	do	Clear	Clear	do	do	Do.
7[3]	63	63	60	63	65	62	63	65	62	E.	E.	E.	Light	Strong	Strong	do	Cloudy	Cloudy	Muddy	Ebb	do	Flood.
8[4]	59	59	58	62	60	60	62	60	60	NE.	N.	NW.	Strong	do	Light	do	do	Clear	do	do	do	Do.
9[5]	55	62	62	56	60	60	56	60	60	NW.	......	......	Fresh	Calm	Calm	Clear	Clear	Cloudy	do	do	do	Do.
10[6]	60	62	63	60	60	60	60	60	60	NE.	N.	SE.	Light	Light	Light	do	Cloudy	do	do	do	do	Do.
11	59	62	60	59	60	60	59	60	60	NE.	N.	SE.	do	do	Strong	Cloudy	do	do	do	do	do	Do.
12	59	62	60	59	62	61	59	62	61	SE.	SE.	SE.	do	Calm	Light	do	do	do	do	do	do	Low.
13[7]	58	58	57	58	58	58	58	58	58	SE.	NE.	NE.	do	Fresh	do	do	do	Clear	do	do	Flood	Ebb.
14	57	57	58	58	58	58	58	58	58	NE.	SE.	SE.	do	Light	Fresh	do	do	Cloudy	do	do	do	Do.
15[8]	57	59	60	58	59	60	58	59	60	SE.	......	......	Fresh	Calm	Calm	do	do	do	do	Flood	do	Do.
16[9]	58	59	57	58	60	58	58	60	58	NW.	NW.	NW.	do	Strong	Light	Clear	Clear	Clear	do	do	Ebb	Flood.
17[10]	54	59	57	57	60	58	57	60	58	NW.	N.	S.	Light	Light	do	do	do	do	do	do	Flood	Ebb.
18[11]	55	60	58	57	61	61	57	61	61	S.	SW.	SE.	do	Brisk	Fresh	do	Cloudy	Cloudy	Clear	do	do	Do.
19[12]	59	63	60	59	61½	60½	59	61½	60½	S.	S.	S.	do	Light	Light	Cloudy	do	do	do	do	Ebb	Do.
20[13]	58	74	68	60	62	61½	60	62	61½	SE.	SW.	NW.	do	do	do	do	do	Clear	do	do	do	Do.
21	63	72	64	60½	64	62	60½	64	62	N.	S.	......	do	do	Calm	Clear	Clear	do	do	do	do	Flood.
22	65	74	70	62	66	66	62	66	66	SW.	S.	E.	do	do	Strong	do	do	Cloudy	do	Ebb	do	Do.
23[14]	70	74	71	65	69	69	65	69	69	SW.	SW.	SW.	do	do	Light	do	Cloudy	do	do	do	do	Do.
24[15]	68	66	68	68½	68	69	68½	68	69	SW.	NW.	NE.	do	do	do	do	do	do	do	do	do	Do.
25	68	59	59	68	68	65	68	68	65	N.	NW.	NW.	do	Fresh	Strong	Cloudy	do	Clear	do	do	do	Do.
26	54	59	59	65	64	62	65	64	62	NW.	NW.	NW.	Fresh	do	Light	Clear	Clear	do	Muddy	do	do	Do.
27[16]	58	62	64	60	64	63	60	64	63	S.	S.	NW.	Light	Light	do	Cloudy	do	do	do	do	do	Ebb.
28	60	67	64	60	65	64	60	65	64	N.	N.	NW.	do	do	do	Clear	do	do	Clear	do	do	Flood.
29	63	71	67	63	68	65	63	67	64	......	S.	SW.	Calm	do	do	do	do	do	do	do	Flood	Ebb.
30	65	72	72	64	69	66	64	69	66	......	S.	NE.	do	do	do	do	do	Cloudy	do	Flood	do	Flood.
31	69	....	..	66	....	....	66	....	....	NE.	......	......	Light	......	......	Cloudy	......	......	do	do	......	
June 1	61	70	65	65	66	65	64	66	65	......	NW.	NW.	Calm	Light	Light	Clear	Clear	Clear	do	do	Ebb	Ebb.
2[17]	60	78	71	65	70	70	65	70	70	NE.	SW.	SW.	Light	Brisk	do	Cloudy	Cloudy	do	do	do	do	Do.
3[18]	71	68	65	69	70	68	69	70	68	SW.	NW.	NW.	Brisk	Light	Brisk	do	Clear	do	do	do	do	Do.
4[19]	63	70	65	65	70	68	65	70	68	NW.	W.	......	do	Very l't.	do	Clear	do	do	do	do	do	Do.

5	65	77	66	68	68	68	68	68	68	E.	E.	SE.	Very l't	...do	Light	...do	...do	...do	...do	...do	...do	Flood.
6	68	77	65	68	69	68	68	69	68	S.	S.	......	...do	...do	...do	...do	...do	...do	...do	Ebb	...do	Do.
7[20]	65	70½	70	69	71	70	69	71	70	SE.	SE.	......	Light	Light	...do	...do	...do	...do	...do	...do	...do	Do.
8	73	75	72	71	74	73	71	74	73	N.	N.	S.	...do	...do	...do	...do	...do	...do	...do	...do	...do	Do.
9[21]	69	71	72	73	73	73	73	73	73	S.	SE.	SW.	...do	Fresh	...do	...do	Cloudy	Cloudy	...do	...do	...do	Do.
10[22]	71	76	77	72	76	75	72	76	75	NW.	SW.	N.	...do	Light	...do	Cloudy	Clear	...do	...do	...do	Flood	Do.
11	77	76	78	78	76	75	78	76	75	N.	NW.	N.	...do	...do	...do	Clear	...do	Clear	...do	...do	...do	Ebb.
12	71	78	71	76	76	75	76	76	75	NE.	N.	SE.	...do	...do	...do	...do	...do	...do	...do	...do	...do	Do.

[1] Tide very low; no water in tank from 2 a. m. to 3.18 a. m.
[2] Rain from 4 a. m. to 6.30 a. m.
[3] Rain at 11 a. m.
[4] Rain; stopped at 4 p. m.
[5] Water very muddy.
[6] Rain from 10.20 p. m. to 11 p. m.
[7] Rain from 6.30 a. m. to 9.15 p. m.
[8] Rain from 6.30 p. m. to 11 p. m.
[9] Strong wind and current, making ebb run over its time.
[10] Water began to clear at 4 p. m.; current falling fast.
[11] Rain at 11 p. m.
[12] Stopped raining at 9 a. m.
[13] Rain from 4 a. m. to 2.45 p. m.
[14] Rain from 1.15 a. m. to 3.45 a. m.
[15] Rain from 11.50 a. m. to 2 p. m.
[16] Rain from 8.45 a. m. to 11.45 a. m.
[17] Day rather warm; light drizzle in early morning.
[18] West wind making very high tides.
[19] Wind blowing northwest for several days kept tide back.
[20] Rain from 1 p. m. to 2 p. m.
[21] Rain from 12.50 p. m. to 5 p. m.
[22] Began raining at 7 p. m.

TABLE III.—*Statement of shipments of shad fry made from Battery Station, Havre de Grace, Md., in April, May, and June, 1886.*

State.	Place of deposit.	Stream.	Date.	Number sent.
Maryland	Near Battery Station[1]	Susquehanna River	Apr. 25	25,000
Do	do[1]	do	Apr. 26	1,421,000
Do	Below Port Deposit[1]	do	Apr. 27	2,431,000
			Apr. 27	([2])
Maryland	Near Battery Station[1]	Susquehanna River	Apr. 28	860,000
Do		Northeast, Gunpowder, and Bush Rivers.[4]	Apr. 28	1,500,000
Do	Above Havre de Grace[1]		Apr. 29	1,055,000
Do	Near Battery Station[1]		Apr. 30	50,000
Do		Gunpowder, Northeast, and Patapsco Rivers.[4]	Apr. 30	1,430,000
Do		Bush and Elk Rivers[4]	May 1	1,200,000
Pennsylvania	Harrisburg[4]	Susquehanna River	May 3	1,621,000
Maryland	Near Battery Station[1]		May 3	[5]1,952,000
Rhode Island	Providence[4]	Narragansett Bay	May 5	1,500,000
Maryland	Near Battery Station[1]		May 5	804,000
Do	Below Port Deposit[1]		May 6 May 7	1,245,000
Do		Chester River[6]	May 8	500,000
Do		Patuxent River[6]	May 9	650,000
Oregon		Columbia River.[7]	May 9	1,000,000
Do		do[7]	May 9	([8])
Maryland		Northeast River[6]	May 10	500,000
South Carolina	Columbia[4]	Broad and Saluda Rivers	May 10	1,500,000
Maryland		Gunpowder River[6]	May 11	600,000
Do		Bush River[6]	May 11	300,000
Do		Northeast River[9]	May 11	1,500,000
Do		Northeast and Elk Rivers[6]	May 12	600,000
Do		Northeast River and flats off Locust Point.[10]	May 12	1,500,000
West Virginia	Grafton[11]	Monongahela River	May 12	250,000
Maryland		Brandywine and Nanticoke Rivers.[6]	May 13	900,000
Do	Off Ordinary Point[9]	Sassafras River	May 13	1,000,000
Georgia		Withlacoochee and Ocklockonnee Rivers.[4]	May 14	1,500,000
Virginia	Clifton Forge[11]	James River	May 14	250,000
New York	Near Oswego[6]	Lake Ontario	May 14	([12])
Maryland		Chester River[3]	May 14	600,000
Do	Below Port Deposit[1]	Susquehanna River	May 15	370,000
Delaware		Brandywine River[3]	May 16	450,000
West Virginia	Rowlesburgh[11]	Cheat River	May 17	300,000
Maryland	Millington[3]	Chester River	May 18	600,000
Delaware	Seaford[6]	Nanticoke River	May 18	450,000
Maryland	Salisbury[6]	Wicomico River	May 19	450,000
Do		Patuxent River[3]	May 19	540,000
West Virginia		Monongahela River[11]	May 21	300,000
Pennsylvania	Near Columbia[6]	Susquehanna River	May 24	895,000
Maryland	Above Port Deposit[6]	do	May 25	750,000
Pennsylvania	Peach Bottom[6]	do	May 26	836,000
Do	Marietta[4]	do	May 26	1,500,000
Delaware	Seaford[7]	Nanticoke River	May 27	977,000
Maryland	Conowingo[6]		May 28	500,000
North Carolina	Fayetteville[4]	Cape Fear River	May 29	1,100,000
West Virginia	Fairmont[11]	Monongahela River	May 30	200,000
Pennsylvania	Safe Harbor[6]	Susquehanna River	May 31	550,000
Do	Tides Eddy[6]	do	June 1	500,000
Maryland	Above Havre de Grace[3]	do	June 2	100,000
Do	Below Havre de Grace[1]	do	June 5	228,000
Do	do[1]	do	June 7	429,000
Do	Near Battery Station[1]	do	June 9	472,000
Do	do[1]	do	June 10	298,000
Do	do[1]	do	June 12	481,000
Do	do[1]	do	June 13	256,000
Total				43,776,000

[1] By employees of station.
[2] Fifty thousand eggs on trays shipped to H. C. Mercer, by steamship Eider, for Danube River.
[3] By R. H. Dana.
[4] By N. Simmons, car No. 1.
[5] Eggs almost hatched when put into river.
[6] By F. L. Donnelly.
[7] By J. F. Ellis, car No. 3.
[8] Delivered 585,000 eggs in good order.
[9] By steamer Lookout.
[10] By launches Nos. 68 and 82.
[11] By H. E. Quinn.
[12] Seventy-five thousand rockfish.

Vol. VI, No. 24. Washington, D. C. Dec. 31, 1886.

112.—NOTES ON AN INVESTIGATION OF THE GREAT FISHING BANKS OF THE WESTERN ATLANTIC.*

By J. W. COLLINS.

[Abstract.]

This report covers a trip of twenty-nine days, made in pursuance of instructions from the Commissioner to accompany the Albatross, as fishery expert, to the great fishing banks off the coast of North America.

On June 19, soundings were taken over the region of the two positions assigned to Hope Bank on the charts (about latitude 41° 25′ north, longitude 63° 15′ west), proving that there is no such bank, or even an upheaval of the ocean bed in this vicinity, as a depth of about 2,000 fathoms was uniformly found, under favorable conditions for sounding and determining the ship's exact position. This disproves the existence of what for several years has been a source of speculation to many New England fishermen, and has occasionally caused a loss of time to those that searched for it.†

The next objective point was the position of certain reported "dangers to navigation," laid down on the charts as "rocks awash," at varying distances to the southward of the southern extremity of the Grand Bank of Newfoundland. The whole of the 21st, and the following night and morning, were spent in searching for these "rocks," and the researches proved that no such "dangers" existed, as depths of about 3,000 fathoms were found where these "rocks" were marked on the charts.‡ The results of such searches are of considerable practical value to fishermen.

Early on the morning of June 23, we began dredging with the beam-trawl in 523 fathoms, about 15 miles to the southward of the southern extremity of the Grand Bank, and dredgings were made at regular intervals between that position and the bank, while later in the day many dredgings were made on the bank itself. Perhaps the most important catch of the day, from the standpoint of a fisherman, was the haul made on the bank in 51 fathoms (latitude 43° 08′ north, longitude 50° 40′

* These notes relate to researches made during a cruise of the U. S. Fish Commission steamer Albatross, from June 17 to July 16, 1885, with the object of investigating the fauna and fishing grounds of the chain of great ocean banks between Cape Cod and Newfoundland. An account of this cruise, with tables of dredgings and trawlings, and of fishing stations, is given in Capt. Z. L. Tanner's Report on Work of the Albatross, in the Fish Commission Report for 1885, p. 27 *et seq.*

† See Fish Commission Bulletin for 1885, p. 466.

‡ This is what is referred to in Captain Tanner's Report (p. 28) as Watson's Rock.

west). Here thirty-six specimens of the craig or pole flounder (*Glyptocephalus cynoglossus*) were taken in the beam-trawl, which was on the bottom only a few minutes. These fish were of large size and weighed 106 pounds in the aggregate. The trawl also brought up a very large quantity of ophiurans. Off the southern edge of the Grand Bank, in depths varying from 100 to 300 fathoms, the trawl brought up large quantities of grenadiers (*Macrurus*), blue hake (*Haloporphyrus viola*), soft corals, and a smaller amount of other material.

Several dredgings were made during the early part of the 24th in the shallow water on the eastern edge of the Grand Bank. At dredging station 2437* the trawl brought up considerable quantities of bryozoa, which fishermen call "sea-moss"; where this occurs the ground is known as "mossy bottom." Many flat sea-urchins, commonly called "sand-dollars," were also taken, but there were no fish, excepting one small flounder. At station 2438, near by, most of the material taken consisted of sand-dollars. A rather small amount was brought up in the trawl, among which were broken shells, one skate (*Raia radiata*), one small fish, and a few shells. At station 2439 the trawl brought up a large mass of holothurians, commonly called "sea-pumpkins," a few ascidians (*Boltenia*), known to the fishermen as "sea-lemons," and many small sponges and shells. Among the latter there were many live mussels, some of which were covered with sponges and barnacles. A small amount of bryozoa, sand-dollars, and a few spider-crabs were taken, also one small codfish. The bulk of the material obtained at station 2440 consisted of dead shells, and, so far as could be judged, the bottom where the dredging was made would be what is termed "barren ground." A few small flounders and three haddock were also taken at this station.

The material brought up in the trawl during the forenoon of the 25th did not indicate for the most part a very good feeding ground for cod. At station 2441 very little material was obtained, consisting of a very few shells and some spiny sea-urchins (*Strongylocentrotus dröbachiensis*), sea-lemons (*Boltenia*), a few shrimp, two small skates (*Raia radiata*), and one young sculpin (*Cottus*). At station 2442 the trawl brought up only about one-half bushel of material in all. This was mostly flat sea-urchins. There were also one sea-lemon (*Boltenia bolteni*), one sea-peach (*Halocynthia pyriformis*), several sea-pumpkins (*Pentacta frondosa*), sea-strawberries or soft coral (*Alcyonium ?*), and a few starfish, spiny crabs, and hermit-crabs. There were also some barnacles and several species of shells, chiefly *Saxicava mactrasipho*. Besides these there were a few shrimp.†

---

* For latitude and longitude and other details concerning these stations, see Tanner's Report before cited, p. 66 *et seq.*

† I am indebted to Mr. Sanderson Smith for the identification of the shells, while Mr. J. E. Benedict, resident naturalist on the ship, rendered much aid in identifying many of the species of fish and invertebrates.

At station 2443 we got two or three barrels of sea-urchins, one skate (*Raia radiata*), one sand-dab (*Limanda ferruginea*), a considerable quantity of shells (chiefly varieties of sea-whelks or *Buccinum*), and some hermit-crabs. At station 2444 the trawl brought up about two barrels of sand-dollars, three very small fish of undetermined species, one bank-clam (*Glycimeris*), and a few hermit and spiny crabs. At station 2445 many sea-lemons (*Boltenia*) and other varieties of ascidians were taken, also numbers of spiny sea-urchins, small spiny crabs, hermit-crabs, and a few living and as many dead scallops (*Pecten islandicus*). Comparatively few sand-dollars were obtained, a few worm-eaten stones of varying size, and a quantity of pebbles. There were several small fish of undetermined species and a few shrimp. In this neighborhood but little material was obtained, however, which would be suitable as food for cod, and the inference is that the fish in that vicinity were attracted there principally in pursuit of smaller species (as laut or capelin) which they were feeding upon.

As we proceeded farther north and reached from 46° 20′ to 46° 28′ north latitude, the character of the fauna, as well as of the bottom, changed very materially, and there were not only indications of a greater abundance of food suitable for the cod, but we also had evidence that the fish were far more numerous than they were in the region near station 2443.

At station 2446 the trawl brought up many sea-lemons (*Boltenia bolteni*) and other varieties of ascidians, while flat sea-urchins were few in number. There were also numbers of shrimp, sea-peaches, spiny crabs, hermit-crabs, scallops, also *Trophon clathratus*, *Saxicava*, *Buccinum*, a considerable quantity of pebbles, and a few worm-eaten stones. A few miles northerly from this position fishing schooners were seen at anchor ahead of the ship and on both sides, and one or two vessels were under way shifting their position. Near these, considerable material was taken which indicated an abundance of animal life on the bottom suitable as food for cod.

At station 2447, which was about 3 miles west-southwest by compass from where "Ryder's Rock" is laid down on the charts, the trawl brought up a rather small amount of material, of which about one-half was sand-dollars, and of the remainder sea-lemons were most numerous.

At station 2448 (latitude 46° 28′, longitude 49° 39′ 30″) we sounded and made a haul with the beam-trawl. This is the position where "Ryder's Rock" is laid down on the charts, and the investigations made here determined the fact that no such rock exists, since in this place a depth of 40 fathoms was obtained on a bottom of sand and gravel. Here, the following were obtained: One flounder (*L. ferruginea*), one skate (*Raia radiata*), about 1½ bushels of sand-dollars, and a few crabs, scallops, &c.

After making this haul the ship steamed up near the schooner Keewatin, of Lockport, Nova Scotia, and I went on board to obtain infor-

mation concerning the fishery on the bank. This vessel was getting reasonably good fishing—a dory-load of cod on about 800 hooks of trawl. The captain told me that on his first "baiting"* he had mackerel for bait, which he procured at the Strait of Canso. While using this bait, he caught 225 tubs of codfish in six days, the position of his fishing being latitude 44° 55′ north, longitude 51° 10′ west. He thought that the average catch of the vessels from the United States and the British Provinces would be about 250 tubs (equal to about 400 quintals) on their last baiting. As this would represent about two weeks' work on the bank, it may be considered very good fishing, and the indications pointed to a good season's catch by the Grand Bank fleet, since, of course, each vessel usually has several baitings on a trip.

At station 2449 the trawl brought up about three-quarters of a bushel of various kinds of invertebrates, among which were sea-lemons and spiny sea-urchins. Besides these there were a few scallops (*Pecten islandicus*), shrimp, barnacles, and fish of the *Cottus* genus, also one sponge, some hydroids, hermit-crabs, small stones, &c. At station 2450 sea-lemons and sea-urchins were numerous; shrimp were more abundant than elsewhere in any dredging made during the day; while there were considerable numbers of small fish, two or three starfish, a few hermit-crabs and shells, the latter being chiefly *P. islandicus* and *Buccinum*.

On the morning of the 26th we began dredging at daylight, about 30 miles northwest from the position where we ceased work on the previous evening, this position being in the deep water (about 80 fathoms) northward of the Virgin Rocks, on soft, slimy mud. Dredgings were made at intervals of 6 to 10 miles in the direction of Saint John's, Newfoundland, but the localities where these hauls were made were not on any fishing ground. At five stations (2451 to 2455) a few shrimp, crabs, flounders, starfish, dead shells, one sand-dollar, one small octopus, and some specimens of the basket starfish (*Astrophyton*) were taken.

On the morning of July 2 the ship left Saint John's and headed for Green Bank, and dredging operations were soon begun, the rake or scoop dredge being used. The bottom was generally rocky, and only a small amount of material was obtained, the greater part of it being wave-washed stones. A few shells, sea-urchins, and hermit-crabs were taken.

A little before 6 o'clock on the morning of July 3, soundings were obtained in 59 fathoms (latitude 45° 47′, longitude 54° 13′ 30″) on Green Bank, and fishing lines, baited with fresh capelin, were put out. The ship lay to for 15 or 20 minutes, but no fish were caught nor were there any indications of the presence of cod in the vicinity. After the lines were hauled in, a small dredge was put out and towed for a short time. It came up nearly filled with sand-dollars, with which were also numbers of hermit-crabs, two small flounders, a few sea-urchins,

* The word "baiting" is used in two senses: (1) the amount of bait taken by a vessel at one time; (2) the length of time a vessel is on the banks with a supply of bait. The second is the sense in which it is used here.

and some dead shells. Previous to this a haul had been made with the Blake dredge some 6 or 7 miles in a northeasterly direction, just off the edge of Green Bank, but no fishing lines were put out. The haul at this last position (station 2460) consisted of a few crabs, shrimp, starfish, small stones, sea-urchins, and dead shells.

At station 2462 (latitude 45° 45′ 30″, longitude 54° 20′ 30″) eight hand-lines were put out, but not a single fish was caught. Failing to take any fish in a reasonable length of time, a dredging was made, with practically the same result as that obtained at the previous station. The most remarkable catch made by the dredge was pieces of 2 fresh lant (*Ammodytes americanus*) which had been in some manner intercepted by the dredge.

About 5 or 6 miles farther to the westward, at station 2463 (latitude 45° 44′, longitude 54° 27′), the hand-lines were again baited and put out in a depth of 45 fathoms, the result being precisely the same as at the two previous stations. A haul was made at this position with the ship's dredge. Its contents indicated that considerable material existed on the bottom which might serve as food for the *Gadidæ*, and it is somewhat remarkable that cod were not found in this region. Among other things the dredge brought up many hermit and spiny crabs, sea-urchins, starfish, and sea-anemones.

At station 2464 (latitude 45° 40′, longitude 54° 41′) another trial for fish was made with hand-lines, in 41 fathoms, but none were taken. The dredge was put out, but caught on a rocky bottom and was so badly torn that very little material, save a few crabs and dead shells, was taken in it. At the two succeeding stations hauls were made with the ship's dredge, but no fishing-lines were put out.

At station 2465 there were obtained several ophiurans, sand-dollars in abundance, a few hermit and spider crabs, and some stones.

At station 2466 (latitude 45° 29′, longitude 55° 24′), in a depth of 67 fathoms, a considerable quantity of material was obtained in the dredge which indicated good feeding bottom for fish. Among these were a few small fish, hermit and spiny crabs, many brittle-stars or ophiurans, spiny sea-urchins, sponges, sea-anemones, starfish, soft coral, bryozoa, hydroids, and large numbers of live mollusks, chiefly the Iceland scallop. This position was in what is termed the "gully" between Green Bank and Saint Peter's Bank.

At station 2467, in 38 fathoms, on the southeastern side of Saint Peter's Bank (latitude 45° 23′ north, longitude 55° 41′ west), the dredge contained several holothurians, sand-dollars, spider and hermit crabs, spiny sea-urchins, and shells. Eight hand-lines were put out at this position and 13 codfish were caught in about 20 minutes. These fish were of rather small size, about three-quarters of them not being large enough to cull as "large fish" in the American markets. These were mostly males, with their spermaries undeveloped. The ovaries of the female fish were also very small. I opened their stomachs and took 13 whole,

undigested bank-clams (*Glycimeris*) from them, besides a number of clams which were more or less digested, and several crabs and small fish.

At station 2468 (latitude 45° 11′ 30″, longitude 55° 51′ 30″), a haul was made with the ship's dredge, in 42 fathoms, near the southwestern edge of the bank, and many dead shells of the bank-clam and other varieties were obtained, also soft corals, sand-dollars, sponges, starfish, ophiurans, holothurians, and some stones.

The forenoon of July 4 was spent in making dredgings across the deep plateau which extends from Saint Peter's Bank nearly across to Banquereau, and which has a depth varying from 200 to 225 fathoms. It is probable that this plateau may, in the future, prove to be a valuable fishing ground for halibut, and already on some parts of it, within 15 or 20 miles of the edge of Saint Peter's Bank, good fares of halibut have been obtained.

We found many varieties of marine life, and there was evidence of an abundance of food for halibut, though the bottom was generally muddy and unsuitable for the above-named species. An exception to this was at station 2471 (latitude 44° 34′, longitude 56° 41′ 45″), in 218 fathoms. In this position the beam-trawl was torn on rocky bottom, and what material was obtained indicated a ground suitable for halibut. Among other things, a few shrimp and other forms of crustacea were taken, besides seven species of shells, octopus, grenadiers, some sponges, many small brittle-stars, some small crinoids, bob-tailed squid, coral, and several stones. In the two previous hauls during the morning, Norway haddock and pole flounders were taken, besides Baird's grenadiers, several Chester's hake, and various forms of corals, sea-pens (chiefly *Pennatula borealis*), sea-anemones, 1 octopus, some shells (mostly *Buccinum undatum*, *Astarte*, and *Yoldia thraciformis*), some specimens of the Finmark sea-feather (*Balticina finmarchica*), and quantities of skate's eggs (some with living embryos). Also, there were taken cup-corals (*Flabellum*), many fragile sea-urchins (*Schizaster fragilis*), several species of starfish (the most noticeable being *Hippasteria phrygiana*), sponges, bob-tailed squid (*Rossia megaptera*), 2 *Lycodes*, and 1 *Scopelus*.

At station 2472, and the four succeeding stations, tangles and grapnels were put over in depths ranging from 133 to 222 fathoms; but very little material was obtained. Among other things were a few starfish and sea-urchins, some small samples of deep-water coral (*Primnoa reseda*), and one large specimen of *Macrurus bairdii*.

During the evening Mr. Nye rigged the electric light over the ship's side, and this attracted many marine animals which we thought were young squid. There were probably as many as 50 or 75 of them darting about the light, but all efforts to catch any failed, since they would not bite at a jig, and were too quick to be taken in a dip-net.

As it was deemed advisable to make an investigation about the eastern part of Banquereau, the ship lay by the entire night, drifting. The

current during the night evidently ran in a southwesterly direction, as is usually the case here, and it was found on the morning of the 5th that the ship had drifted considerably from her position on the previous evening. During the day it was impossible to obtain observations, owing to the dense fog, and the only thing that could be done to determine the ship's position was to "feel our way" with the lead around the southeast prong of the bank. This was slow and unsatisfactory work, for this part of Banquereau is not correctly laid down on the charts.

Several dredgings were made on the 5th, but the bottom in this region is so rough that the only apparatus which could be used was the ship's dredge or the tangles, and it was even thought unsafe to leave the dredge on the bottom longer than 5 to 10 minutes. The catch was exceedingly meager, generally consisting chiefly of coarse gravel, pebbles, or sand, with very little life of any kind. The dredgings up to about 1.30 p. m. were made in depths varying from 116 to 265 fathoms. In the afternoon the ship steamed on to the shallower part of the bank, and dredgings were made in depths varying from 33 to 39 fathoms. Practically the same result was obtained in these depths as in the deeper water off the edge of the bank, the contents of the dredge being rather uninteresting.

At station 2489 (latitude 44° 43′, longitude 57° 22′ 45″), in 33 fathoms of water, we made the last dredging for the day, and among other things brought up in the dredge were a few small bank-clams (*Glycimeris*) and a large flounder. Hand-lines were put out baited with fresh capelin, and fishing was carried on for an hour or more, during which time 33 cod and 5 or 6 flounders were taken. The cod were mostly of small size, and their stomachs contained several young bank-clams, and in one a specimen of lant was found.

Soundings were made on Misaine Bank early on the 6th, in 68 fathoms, at station 2491. The dredge was put out, but it brought up little else besides stones. Three hand-lines were also tried, and in about 10 minutes' fishing we caught 3 cod and 1 flounder.

At station 2492 (latitude 45° 22′, longitude 58° 43′ 45″), in 42 fathoms, we found fish abundant, 10 or 12 cod of small size being taken in a few minutes, of which 2 "pairs" were pulled up. The dredge was put out and brought up a few shells and starfish, while crabs and sea-urchins were abundant. Another haul was made with the dredge at station 2493 (latitude 45° 19′, longitude 58° 51′ 15″), in 45 fathoms. Considerable material was obtained here, consisting mostly of stones, shells, starfish, spiny crabs, sea-urchins, and sponges. Many barnacles were found here on the stones, shells, &c. Eight hand-lines were put out, and 2 codfish were taken in 10 minutes' fishing.

At station 2494 (latitude 45° 14′ 30″, longitude 59° 06′ 45″), in 50 fathoms of water, 5 cod were taken on the lines. The tangles were put out at this station and brought up many spiny sea-urchins, and and also 1 or 2 basket starfish (*Astrophyton*).

At station 2495 (latitude 45° 10′, longitude 59° 23′ 45″), in 44 fathoms, the fishing-lines were put out for a few minutes and 1 cod and 1 sand-dab were caught. A haul was made with the tangles, and spiny sea-urchins were found abundant, and some crabs and 1 *Astrophyton* were also taken on them.

At station 2496 (latitude 45° 07′ 30″, longitude 59° 27′ 45″), in 44 fathoms, 5 cod were caught on the hand-lines in a few minutes' fishing, being essentially the same in quality and size as those commonly caught on Banquereau. Here the tangles brought up an abundance of sea-urchins, as before, several small crabs, starfish, two sea-lemons, several dead shells of the bank-clam, and bryozoa. This was the last haul made on Misaine Bank.

This bank, which is of considerable extent, has never been considered of any importance as a fishing ground, and so far as we are aware is not resorted to by American vessels. It was, therefore, deemed highly important to make an investigation of it, so that its value to the fishermen might be determined. The trials for fish that were made, demonstrated the fact that they probably occur all over Misaine Bank in as great abundance as on Banquereau, and are practically the same kind of cod as to size, the majority of them being too small to class as large fish in American markets. In view of the abundance of fish on this bank, it would seem probable that the fishermen have never investigated it, and probably are not aware of its value as a fishing ground.

In the latter part of the day, after the researches on Misaine Bank had been completed, the ship headed for the western part of Banquereau, and occasional dredgings were made in the deep water between the banks, in depths varying from 57 to 130 fathoms. The bottom between these banks is, apparently, composed of mud mixed with stones, pebbles, and occasionally gravel. The beam-trawl was used in these localities, and in some of the hauls a considerable quantity of material was taken, comprising spiny sea-urchins, 4 *Lycodes*, 1 pole flounder, 1 sand-dab, large quantities and many varieties of shells, many shrimp, starfish, brittle-stars, &c.

The ship left Banquereau about 3 a. m. on the 7th, and steamed across to the Middle Ground, which was reached about 7.30 a. m. Dredgings were then begun and continued at intervals throughout the day. The general result of the hauls on Middle Ground and on the northwest prong of the Western Bank, which we crossed later in the day, indicated for the most part an abundance of life on the bottom, much of it of a character suitable for food for the cod and other ground-feeding species.

At station 2500 the trawl brought up the following: One craig or pole flounder, 2 species of ferruginous flounder, 3 or 4 young skates (*Raia radiata*), many starfish (chiefly *Asterias vulgaris*), large quantities of shells (the most noticeable of which were bank-clams), sea-scallops

(*Pecten islandicus*), *Neptunea decemcostata*, *Mactra ovalis*, and *Buccinum undatum*. There were also great numbers of spiny sea-urchins, a few specimens of sea-corn (*Buccinum* eggs), and sea-strawberries or soft coral.

At station 2501 (latitude 44° 27′, longitude 60° 20′ 15″), in 26 fathoms of water, several hand-lines were put out, and 3 cod, 1 haddock, and several sand-dabs were taken. The cod were gorged with food. From one that weighed only 10 pounds I took 12 lant (*Ammodytes americanus*), 1 spiny crab, and the fin of another cod. Another fish, which weighed 7 pounds, had 8 lant and a small stone in its stomach. A third cod, of about 5 pounds' weight, had 4 crabs in its stomach but no fish. The ovaries and spermaries of these fish were undeveloped. In the trawl at this station there was an abundance of sand-dollars, common starfish (*Asterias vulgaris*), twelve large sand-dabs or ferruginous flounders, 1 sculpin (*Cottus*), a few skate eggs, many live and dead shells, among which were a few specimens of *Natica heros*. There were also several hermit-crabs. Two torpedoes were exploded at the bottom near this station, but with no decisive result.

At station 2502 the trawl was torn on rough bottom. It nevertheless contained many basket starfish (*Astrophyton*), some sponges, large starfish, a few brittle-stars (ophiurans), some spiny sea-urchins, hermit-crabs, small skates (*Raia*), sculpins (*Cottus*), and various kinds of shells, among which were *Pecten islandicus*, *Buccinum*, and *Neptunea*. A few shrimp were also taken.

The bottom on the northwest prong was found to be rather rocky, and at station 2503 (latitude 44° 22′ 30″, longitude 61° 00′ 15″), in 47 fathoms, the beam-trawl was torn to pieces, so that nothing was caught in it. Medium-sized codfish appeared to be abundant, and in a few minutes' fishing with hand-lines 22 specimens were taken, 5 of which were large fish. One of these cod had ovaries well advanced, but the generative organs of the others were undeveloped. The stomachs of the fish were generally full of various kinds of material. One had a partially digested herring and squid in its stomach, besides several crabs more or less decomposed. It is evident that crustacea, particularly spiny crabs, are most generally eaten by the cod in this region, so far as can be judged from the contents of their stomachs. But some fish had worms, others brittle-stars, shells, &c., mixed in their stomachs with crabs or fish, while others had apparently nothing but fish. In one we found 5 worms and 4 crabs, while another had 4 spiny crabs, 1 hermit-crab, and 3 brittle-stars in its stomach.

At station 2504 the dredge came up filled with mud but containing very little animal life, only a few worms and small shells; while at station 2505 the trawl contained several small skates, 3 craig flounders, many large sea-anemones of 2 species, fragile sea-urchins (*Schizaster fragilis*), starfish, worms, and small shells.

On July 8, dredging operations were resumed at a little after 4 a. m., and four dredgings were made during the day, while the vessel was heading for Halifax.

At station 2506 the catch was principally fish, as follows: Seventeen Norway haddock (*Sebastes marinus*), 5 pole flounders, 1 small skate, 1 goose-fish (*Lophius piscatorius*). There were also many sponges of several varieties, 3 species of sea-anemones, large numbers of "lamp-shells" (*Terebratulina*), 3 or 4 species of starfish, many large shrimp, and a very few sea-urchins.

At station 2507 the dredge was filled with stones, many of them as large as the mouth of the bag would admit. The amount of animal life taken was small, comprising 3 species of holothurians, 2 or 3 specimens of starfish, and a few worms.

In the afternoon the Albatross reached Halifax, where she remained until July 11, during which time I busied myself in obtaining details concerning various types of boats and vessels employed in the Nova Scotia fisheries.

Four hauls were made during July 11, 2 with the ship's dredge and 2 with the large beam-trawl. All of these dredgings were made on soft bottom, between Halifax and La Have Bank, in depths varying from 68 to 134 fathoms. The first attempt to dredge, however (at station 2510), resulted in the loss of the dredge and 79 fathoms of wire dredge-rope. At station 2511 the dredge was nearly filled with mud and stones, among which was very little animal life. A few shells, holothurians, and starfish were taken. At station 2512 the dredge was filled with soft sticky mud, in which were 2 sea-pens (*Pennatula aculeata*), 1 holothurian, and a few ascidians.

The most interesting haul, so far as fish are concerned, was made with the large beam-trawl at station 2513 (latitude 43° 34′, longitude 63° 56′ 30″), in 134 fathoms, on a bottom of gray ooze. Among other things the trawl contained 10 Norway haddock, 4 common hake (*Phycis chuss*), many large shrimp, and 2 young pole flounders. Since the latter species will probably some time become of value commercially, their occurrence here is of interest, for it shows a wide distribution of this fish in depth as well as in area. The haul comprised also several specimens of Baird's grenadiers (*Macrurus bairdii*), many brittle-stars, 3 or 4 species of sea-anemones, starfish (*Archaster*), sea-pens (*Pennatula*), some large specimens of *Dentalium*, and quantities of large *Terebratulina*.

At station 2514 the following material was taken: One Baird's grenadier, 3 species of sea-anemones, large numbers of fragile sea-urchins (*Schizaster fragilis*), large shrimp, and various species of starfish and sponges; also some stones.

At 11 p. m. the ship stopped on La Have Bank. Mr. Nye put an electric light over the side and soon there were numbers of bill-fish darting about it, and squid were seen also. Several of the bill-fish were

caught, but it was found impracticable to capture any of the squid, as they would not bite a jig and could not be taken by other means.

Work was begun early in the morning of July 12, and a line of dredgings and trials for cod, with hand-lines, was run across La Have Bank, beginning on its eastern side and extending to the southeast part of Brown's Bank. These operations were carried on in depths ranging from 47 to 104 fathoms. In all the dredgings except the last, which was made in 104 fathoms, the ship's dredge was used, it not being possible to use the beam-trawl, owing to the rocky character of the bottom. The difficulties of dredging on such bottom are very great, as was evident by the loss of a dredge on the second attempt for the day (at station 2516), while in most instances the dredge came up more or less nearly filled with stones, pebbles, and coarse gravel, and the amount of animal life was generally very small.

At station 2517 (latitude 43° 10′, longitude 64° 18′), in 55 fathoms, bottom of yellow sand and black specks, 4 hand-lines were put out, baited with capelin, and 12 cod were caught, these averaging about two-thirds large fish (*i. e.*, over 30 inches in length). The bait we used was very soft and would scarcely stay on the hooks until they reached the bottom. Fish were fairly abundant, and with fresh squid bait could probably have been caught in large numbers. Nearly all the cod taken at this station had squid (*Ommastrephes illecebrosus*) in their stomachs, in a more or less digested condition, and they had also been feeding on bank-clams (*Glycimeris*). The animal life brought up by the dredge at this station comprised 2 species of sea-urchins (the sand-dollar and spiny sea-urchins), 2 species of starfish, 2 spider-crabs, 1 sea-anemone, several sea-spiders (*Pycnogonum*), and various kinds of dead shells.

At station 2518 the dredge was filled with stones of various sizes up to 6 or 8 inches in diameter. To these were attached some small sponges. In the dredge were also a few ascidians, a starfish, and some shells.

A little after meridian a 10-pound torpedo was exploded on the bottom at hydrographic station 821, in 47 fathoms, rocky bottom (latitude 43° 01′ north, longitude 64° 45′ 30″ west), but no results were obtained. After the explosion of the torpedo 3 hand-lines were put out for from 20 to 30 minutes, and 4 cod and 1 haddock were caught.

At station 2520 the dredge was filled with coarse gravel and stones, among which the most noticeable forms of life were some shells (*Dentalium* and *Leda*), large numbers of worm-tubes of sand and gravel, containing live worms (*Nothria*). There were 2 young sculpins and a few shrimps, sponges, ascidians, and barnacles. At station 2521 the dredge was partially filled with clean coarse gravel, with a few small stones. It contained almost no living animals, a single starfish and a few dead shells being the only objects of interest.

The last dredging for the day was made with the small beam-trawl on the southeast slope of Brown's Bank, in 104 fathoms, sandy and grav-

elly bottom, at station 2522 (latitude 42° 20′, longitude 65° 07′ 30″). The trawl was dragged over the bottom only a few minutes, because of the supposed rough nature of the ground. But, nevertheless, the net was cut through and probably much of the material taken in the apparatus escaped before the trawl was hove up. Of the material saved, shrimp of two or more species were abundant. There were also young Norway haddock or rose-fish (*Sebastes marinus*), a few sculpins, and several other varieties of small fish, some of them apparently immature. Among the invertebrates the most noticeable were several species of starfish, some large deep-sea barnacles, sea-anemones, sea-spiders, and some young spiny sea-urchins. The fauna of this region is of special interest, since in this locality and its immediate vicinity, in somewhat deeper water, the halibut fishery has been pursued with considerable success, while a few miles northwest, in from 55 to 65 fathoms, many good fares of cod have been obtained.

On the 13th, researches were carried on in deep water, in the so-called "gully" between Brown's Bank and the northeast extremity of George's Bank. This locality has become somewhat celebrated as a deep-water halibut ground upon which gorgonian corals of extraordinary size and in considerable abundance have been found by the fishermen, these corals being often hauled up on the lines with which they become entangled. Attempts were made by means of the dories and with grapnels to secure some of this coral, but without much success, two specimens of the great tree-coral (*Primnoa reseda*) being obtained.

During the forenoon several hauls were made with the ship's dredge, in depths varying from 72 to 121 fathoms, but only a small amount of marine life was obtained. The rough character of the ground precluded the possibility of using the beam-trawl, otherwise it is probable that a larger quantity and a much greater variety might have been secured.

At station 2523 the dredge was filled with stones, coarse gravel, and pebbles. Among these were a few holothurians of two species, lamp-shells (*Terebratulina*), sea-anemones, worm-tubes, sponges, shrimp, small starfish, brittle-stars, sea-urchins, and 2 or 3 small sprays or branches of gorgonian coral. At station 2524 the dredge contained stones and pebbles, with a very small amount of life, as follows: A few sponges, shrimp, lamp-shells, small starfish, holothurians, and ascidians.

At station 2525 the dredge was filled with coarse gravel and stones, while sponges and shells were more numerous than in the preceding haul. Ascidians were plentiful, but there was very little crustacean life. At station 2526 the dredge was filled with coarse gravel and stones, while containing very few living animals, as follows: Small sea-anemones, small holothurians, various kinds of small shells, a few brittle-stars, and 2 or 3 shrimp.

At station 2528 (latitude 41° 47′ north, longitude 65° 37′ 30″ west) a haul was made with a large beam-trawl in 677 fathoms on a bottom of brown mud, where a large amount of material was taken, which so

closely resembled the fauna so often brought up on the halibut lines from the deep-water fishing areas, that it seems desirable that mention should be made of it, although, strictly speaking, this haul was made beyond the limits frequented by fishing vessels. Among the material brought up were many blue hake (*Haloporphyrus viola*), grenadiers (*Macrurus*), 3 pole flounders (*Glyptocephalus cynoglossus*), a number of other species of fish not identified, a large amount of the little bush-coral (*Acanella normani*), specimens of gold-banded coral (*Keratoisis ornata*), 2 or 3 species of sea-anemones, soft sea-urchins, and several species of shells.

It is worthy of note that swordfish and finback whales were seen in unusual abundance on July 13. During the first part of the day as many as 20 swordfish were seen in from 6 to 8 hours; frequently 2 or 3 were in sight at the same time. As many as 20 whales were seen at one time during the morning, and a still greater number were seen in the afternoon. At station 2528 they were very numerous, apparently feeding on small crustacea, probably from 40 to 50 whales being in sight at one time. They were all finbacks, so far as I could tell. Their movements were sluggish, as they "played" back and forth in the tide rips, with their mouths open, the upper jaw just at the surface, scooping in "feed." They were joined by a school of porpoises (probably *Delphinus delphis*), which drove in among the whales, their movements indicating that they were feeding, but of this we could not be sure.

The electric light was put over the ship's side soon after dark and Mr. Nye succeeded in catching seveal specimens of young squid and some small fish of the genus *Scopelus*.

The researches on the fishing banks terminated on the 13th, and the ship arrived at Wood's Holl on July 16, thus ending the cruise.

GLOUCESTER, MASS., *November* 27, 1886.

113.—A CURIOUS KNIFE FOUND IN THE FLESH OF A CODFISH.

By J. W. COLLINS.

While discharging a fare of codfish from the schooner Vinnie M. Getchell, at Gloucester, Mass., on September 15, 1886, Capt. John Q. Getchell,* master of the vessel, found imbedded in the thick flesh of a

* It may be of interest in this connection to say that Captain Getchell is well known in Gloucester as a veteran fisherman, he having been in command of vessels engaged in the George's fishery for the past twenty years; during which time, he tells me, he has eaten only three Thanksgiving and four Christmas dinners on the land. He is a native of Maine, about fifty years old. When the news of Sumter's fall reached the North, he enlisted and served three years in the Third Maine under Colonel (afterwards General) O. O. Howard. He then exchanged his gun and a soldier's bivouac for nets, lines, and the deck of a fishing-vessel. His integrity and truthfulness are unquestioned.

large cod a knife of curious workmanship, represented by the accompanying illustration, which is of full or natural size.

The fish in which the knife was found was one of a fare caught in 75 fathoms of water on the northeast part of George's Bank; it was apparently healthy, being thick and "well-fed," and, according to Captain Getchell, would weigh about 40 pounds after being split, or say 60 pounds as it came from the water. The general excellent quality of the fare of fish attracted considerable attention from people who saw them, and led to the discovery of the knife. Some remarks having been made concerning the fish, Captain Getchell lifted several of them from a tub (where they had been thrown to wash after being weighed) and exhibited them to the by-standers, commenting on the size and thickness of the specimens. Holding one across the edge of the tub in a semi-curved position, he ran his hand over the thicker portion of the fish to call attention to its fatness. In doing so, he felt something hard beneath his fingers, and further examination produced the knife. Of course much surprise was expressed by those present, who had never before seen such a strangely formed implement, and speculation was rife as to how it came there. When found, the knife-blade was closed, and the small or posterior end of the handle was the part first felt by Captain Getchell, and was nearest the tail of the fish.

The flesh of the fish where the knife was imbedded is estimated to have been $2\frac{1}{2}$ inches thick. Unfortunately, the excitement attending the finding of the knife prevented any notice being taken of the fish, which was carried off and salted among the others; therefore nothing is known as to whether the implement was encysted or not.

The handle of the knife is of brass, curved and tapering posteriorly, with a longitudinal incision, on the concave side, to receive the edge of the blade. The handle is remarkable in form, and is suggestive of the handiwork of some savage tribe or the scrimshaw work of a sailor. Its length, measured with the curve, is $3\frac{5}{8}$ inches, and its greatest diameter one-half inch.

The blade is lanceolate in form, with the cutting edge curved outward, to fit into the handle, and the back nearly straight. It has been corroded a good deal and the extreme point is very thin. Its length, from handle to tip, is $2\frac{3}{4}$ inches;

greatest thickness (near the handle), one-eighteenth inch; and its greatest breadth a little less than one-half inch. The total length, from point to point in a straight line, is 6¼ inches.

How did the knife get there? is the question that will be asked by those who are not too skeptical to credit the story of its being found as has just been stated. Personally, I neither doubt the finding of the knife, nor the probability of its being found as stated. It is a fairly common occurrence for fishermen to find the sand-launce, or lant, imbedded in the flesh or the liver of the cod, and dried very hard. I have many times seen lant thus imbedded, and in no case that I remember was the cod any the worse for it.* It is therefore evident that it is possible for the stomach of a cod to be penetrated by a sharp-nosed fish or by an implement it has swallowed, and ultimately for either to work its way through and become imbedded in the flesh, while the wound heals and the stomach goes on to perform its ordinary functions.

As to where the fish got the knife we can only conjecture, unless some ethnologist can point out its origin. In any case, the finding of such a remarkable implement in such a strange place must be a matter of interest to the ethnologist and naturalist alike.

GLOUCESTER, MASS., *December* 31, 1886.

114.—SOME STATISTICS OF THE FISHERIES OF NORTHERN JAPAN.

By JOHN C. CUTTER, M. D.,

Professor in the Imperial College of Agriculture at Sapporo.

The Department of the Hokkaido was organized in March, 1886. Its jurisdiction extends over Yesso† and the Kooril Islands. Sapporo Ken was one of the three prefectures into which Yesso was divided in 1882. It embraces 3,808 square ris of the 5,056 square ris of Yesso, a ri being equal to 2.44 English miles. Its population in 1883 was 91,971 Japanese, Ainos, and Americans. Its coast-line is about 550 miles in extent. Commencing at Abushita on the west coast (Abushita is about 40 miles south of Cape Kamoi, the westernmost point of the peninsula jutting into the Sea of Japan south of Strogonov Bay on the western coast of Yesso) it extends northerly to Cape Soya (Strait of La Perouse), thence southeasterly about 70 miles to Tonainshi, the boundary of Nemuro Ken. The east coast-line commences near the westernmost shore of Volcano Bay (where the Pacific approaches nearest to the shores of the Sea of Japan) and extends east to Cape Yerimo, thence northeasterly about 70 miles to Chokubetsu just east of the mouth of the Tokachi River, the other sea limit of Nemuro Ken.

---

* For curious articles found in codfish, see History of Aquatic Animals, text, p. 212.

† For an article on the fisheries of Hokkaido, see F. C. Bulletin for 1886, p. 342.

The following tables give a summary of the latest statistics of the fisheries in Sapporo Ken.

TABLE I.—*Product of the fisheries from* 1878 *to* 1883.*

Kind of fish.	1878.	1879.	1880.	1881.	1882.	1883.
	Kokus.†	*Kokus.*	*Kokus.*	*Kokus.*	*Kokus.*	*Kokus.*
Herring (*Clupea harengus*)	295, 141	457, 777	501, 030	444, 830	538, 330	412, 672
Spring salmon (*Oncorhynchus perryi*)	445	1, 213	658	721	440	2, 091
Fall salmon (*Oncorhynchus haberi*)	27, 895	52, 244	51, 013	45, 548	66, 695	59, 206
Cod (*Gadus brandtii*)	6, 887	5, 878	9, 274	3, 048	6, 002	5, 388
Pilchard (*Clupea melanogastrula*)	12, 399	6, 686	12, 662	5, 696	5, 906	7, 942
Bêche-de-mer ("namako") (*Stichopus japonicus*)	573	269	394	264	708	1, 363
Ear-shell ("awabi") (*Haliotis gigantea*)	1, 890	599	567	1, 235	1, 055	623
Cuttle-fish	172	76	693	93	203	259
Edible sea-weed ("kombu") (*Laminaria japonica*)	38, 220	49, 949	38, 428	63, 729	46, 510	46, 988
Total	383, 622	574, 691	614, 719	565, 164	665, 849	536, 532

* A partial statement of the product for 1884 in kokus was as follows: Herring, 560,650; spring salmon, 1,236; fall salmon, 36,541; and cod, 6,480.
† A koku equals 7.55 cubic feet.

TABLE II.—*Value of the fisheries from* 1878 *to* 1883.*

Kind of fish.	1878.	1879.	1880.	1881.	1882.	1883.
	Yens.†	*Yens.*	*Yens.*	*Yens.*	*Yens.*	*Yens.*
Herring (*Clupea harengus*)	1, 329, 350	2, 948, 958	4, 035, 780	2, 766, 792	2, 960, 822	2, 063, 360
Spring salmon (*Oncorhynchus perryi*)	4, 005	7, 281	3, 510	5, 948	3, 520	12, 546
Fall salmon (*Oncorhynchus haberi*)	202, 265	312, 893	563, 443	388, 068	533, 560	355, 236
Cod (*Gadus brandtii*)	68, 204	70, 538	57, 610	17, 180	78, 026	54, 656
Pilchard (*Clupea melanogastrula*)	76, 454	62, 425	109, 642	32, 752	41, 342	51, 623
Bêche-de-mer ("namako") (*Stichopus japonicus*)	42, 982	2, 156	35, 514	39, 600	106, 200	204, 404
Ear-shell ("awabi") (*Haliotis gigantea*)	108, 708	43, 167	43, 511	92, 625	79, 125	46, 725
Cuttle-fish	3, 113	1, 529	25, 971	2, 139	4, 669	5, 957
Edible sea-weed ("kombu") (*Laminaria japonica*)	160, 524	254, 246	136, 419	267, 661	186, 040	160, 958
Total	1, 995, 605	3, 703, 193	5, 011, 400	3, 612, 765	3, 993, 304	2, 955, 465

* For the value of the Sapporo fisheries in 1884, see Fish Commission Bulletin for 1886, p. 345.
† The values are expressed in yen paper. Taking the silver yen (416 grains, nine-tenths silver, now worth about 80 cents) at 100, the paper yen has about the following relative values: In 1878, $1.05; in 1879, $1.16; in 1880, $1.79; in 1881, $1.70; in 1882, $1.60; in 1883, $1.26, and in 1884, $1.11.

Additional facts for 1883.—Fishermen in the Ken (or district), 16,064; "Yatoi" or hired men, who come from Hondo (the main island) annually, 28,065; fishing smacks, 5,411; trap-nets, 1,790; seines, 350; gill-nets, 35,394.

The taxation on the products of the sea and river ranges from 7 to 20 per cent of the product. The cost of collection ranges in different years from one-third to nearly one-half of the tax collected. For the most part it is collected in kind. The number of tax collectors and officials for attending to this, the only paying industry of Hokkaido, is very large. It is, however, the intention of the Hokkaido Cho to diminish the tax, to simplify the collection, and to reduce the number of officials.

SAPPORO, HOKKAIDO, JAPAN, *May* 14, 1886.

Vol. VI, No. 25. Washington, D. C. Dec. 31, 1886.

115.—REPORT ON DISTRIBUTION OF FISH AND EGGS BY THE U. S. FISH COMMISSION FOR THE SEASON OF 1885-'86.

By MARSHALL McDONALD.

The distribution of young carp, whitefish, shad, and various species of *Salmonidæ* is made chiefly by car or detached messenger service, the organization of which the present year was the same as that of 1884. The distribution of eggs and of carp and trout to applicants not located sufficiently near to the centers of distribution is made by express.

During the season of 1885 the cars of the Commission were moved 74,805 miles, as follows:

Car No. 1, N. Simmons in charge	24,939
Car No. 2, Geo. H. H. Moore in charge	34,061
Car No. 3, J. F. Ellis in charge	15,805
Total	74,805

Of the above transportation, 26,212 miles were furnished by the railroads gratuitously, and 48,593 miles were paid for at the rate of 20 cents per mile. The Commission is indebted to the *personnel* and management of the railroads for much courtesy, consideration, and dispatch.

The following summaries of the number of fish and embryonized eggs distributed show (1) the distribution by species, (2) the station whence they were derived:

Fish and eggs furnished for distribution by the stations during the season of 1885–'86.

Station.	Species.	Eggs.	Fry.	Large fish.
Grand Lake Stream, Me	Landlocked salmon	222,000		
Bucksport, Me	Atlantic salmon	1,251,500		
Northville, Mich	Whitefish	42,800,000	52,000,000	
	Brook trout	145,000	25,000	550
	Lake trout	1,031,000	75,500	
	Rainbow trout	5,000		3,364
	Landlocked salmon		22,000	
Alpena, Mich	Whitefish		40,000,000	
Baird, Cal	Rainbow trout	246,000		
Wytheville, Va	do	30,000	250	1,300
	Lake trout			1,791
	Black bass		500	
	Red-eye perch		250	
Cold Spring Harbor, N. Y	Atlantic salmon		419,550	
	Landlocked salmon		19,500	
	Brown trout		28,900	
Battery Station, Md	Shad		10,725,000	
Steamer Fish Hawk (Delaware River)	do		8,063,000	
Steamer Lookout (Delaware and Susquehanna Rivers).	do		340,000	
Central Station	do	325,000	15,531,000	
Carp ponds, Washington, D. C	Carp for public waters		161,370	
	Carp for private ponds		187,414	
	Goldfish		4,344	
Total		46,055,500	127,603,578	7,005

Summary of distribution for the season of 1885–'86.

Species.	Number of eggs.	Number of fish.	Total.
Whitefish (*Coregonus clupeiformis*)	42,800,000	92,000,000	134,800,000
Brook trout (*Salvelinus fontinalis*)	145,000	*25,550	170,550
Lake trout (*Salvelinus namaycush*)	1,031,000	†77,291	1,108,291
Rainbow trout (*Salmo irideus*)	281,000	‡4,914	285,914
Atlantic salmon (*Salmo salar*)	1,251,500	419,550	1,671,050
Landlocked salmon (*Salmo salar* subsp. *sebago*)	222,000	41,500	263,500
Brown trout (*Salmo fario*)		28,900	28,900
Shad (*Clupea sapidissima*)	325,000	34,659,000	34,984,000
Carp (*Cyprinus carpio*)		§348,784	348,784
Goldfish (*Carassius auratus*)		4,344	4,344
Black bass (*Micropterus dolomici*)		500	500
Red-eye perch (*Ambloplites rupestris*)		250	250
Total	46,055,500	127,610,583	173,666,083

* Of this number, 550 were one or more years old.
† Of this number, 1,791 were one or more years old.
‡ Of this number, 4,664 were one or more years old.
§ Of this number, 187,414 were for private ponds and 161,370 for public waters.

The details of distribution summarized above are as follows:

(*a*) WHITEFISH (*Coregonus clupeiformis*).

Of this species 42,800,000 eggs were distributed from Michigan stations the present season and were allotted as follows:

To the State commissioners, to be hatched and planted in public waters	34,800,000
To foreign countries (international exchange)	6,000,000
To other U. S. Fish Commission stations	2,000,000
Total	42,800,000

The eggs which were retained and hatched at the stations yielded 92,000,000 fry, which were distributed as follows:

To Lake Michigan	29,000,000
To Lake Superior	6,000,000
To Lake Huron	30,000,000
To Lake Erie	15,000,000
To Lake Ontario	12,000,000
Total	92,000,000

The distribution was made by two cars instead of one, as heretofore, with the result of securing greater dispatch in the work and distribution of fry under better conditions.

(*b*) MORANKE (*Coregonus albula*).

We are indebted to the courtesy of the Deutsche Fischerei-Verein for two consignments of eggs of this small species of whitefish. The total number received aggregated 150,000, which were allotted as follows:

To C. G. Atkins, Bucksport, Me., for hatching and planting in Maine waters.	100,000
To F. N. Clark, Northville, Mich., for stocking lakes in Northwestern States.	50,000

(c) Brook trout (*Salvelinus fontinalis*).

Eggs of this species are collected at the Northville Station from fish reared in ponds. The number furnished for distribution during the winter of 1885-'86 was 145,000, which were assigned as follows:

To State commissioners and individuals	50,000
To Wytheville Station, United States Commission, for hatching and rearing	50,000
To foreign countries (international exchange)	45,000
Total	145,000

The eggs retained at the station to be hatched yielded 25,000 fry. Of these 4,000 were distributed to applicants in Michigan and Indiana, and the balance retained at the station for rearing.

(d) Lake trout (*Salvelinus namaycush*).

The eggs of this species distributed by the U. S. Fish Commission are all collected at the Northville Station. The total assignments of eggs the present season aggregated 1,031,000; these were distributed as follows:

To State commissioners and individual applicants	406,000
To other United States stations, to be hatched and reared	450,000
To foreign countries (international exchange)	175,000
Total	1,031,000

The eggs retained at the station yielded 115,500 fry, which were disposed of as follows:

To applicants in Ohio, Indiana, and Michigan	75,500
Retained at the station, to hatch and rear	40,000

(e) Rainbow trout (*Salmo irideus*).

Eggs of this species are collected for propagation and distribution at Baird Station, California; Northville Station, Michigan; and Wytheville Station, Virginia. At Baird Station the eggs are obtained from wild native fish. At Northville and Wytheville Stations the breeders have been reared from eggs artificially impregnated at Baird Station and hatched and reared at the stations.

The total production available for distribution was as follows:

From Baird Station, California:	
Hatched and planted in McCloud River	28,700
Hatched for ponds at station	11,300
Forwarded to applicants and Eastern United States stations	246,000
From Northville Station, Michigan:	
Forwarded to applicants	5,000
Hatched for rearing at station	30,000
From Wytheville Station, Virginia:	
Forwarded to applicants	30,000
Retained at the station to be hatched and reared	166,000
Total	517,000

Our experience, extending over a number of years, has clearly shown that the results from planting the *fry* of any of the species of *Salmonidæ*

are disappointing and wholly incommensurate to the expenditure incurred.

Instances are rare in which substantial or even appreciable results have been obtained by planting young fish just before, or at the time, the absorption of the sac is complete. This is to be attributed to the fact that usually the streams stocked abound in cottoids, darters, and other species of predaceous fish of small size, which pursue and prey upon the helpless young fish so assiduously that few if any escape capture.

It has been determined, therefore, to retain the young fish at the stations and rear them till they have attained a length of from 4 to 6 inches, and are, consequently, of such size and vigor as to dominate the waters in which they are placed. The percentage of loss in rearing is, it is true, very considerable, but probably not greater than would occur in open waters not infested by predaceous fish; and, since fish of this size are comparatively exempt from natural casualty, it is probable that one pair of yearling trout will contribute as much towards the stocking of the waters as would a plant of several thousand fry.

A beginning in this new direction was made the present season. Rainbow trout, from 4 to 7 inches in length, to the number of 4,664, have been distributed from the Northville and Wytheville Stations. The distribution from Northville was made to lakes and other protected waters in Indiana, Ohio, and Michigan; that from Wytheville to the headwaters of the Shenandoah, in Augusta County, Virginia, to the tributaries of the Potomac River in Washington County, Maryland, and to a number of spring-fed cold-water ponds in Maryland, Southwest Virginia, and Tennessee.

(*f*) Atlantic salmon (*Salmo salar*).

The eggs of this species distributed by the Commission are all furnished by the collecting station at Bucksport, Me. The production for the year aggregated 1,251,500, which were distributed as follows:

To the commissioners of Maine, New Hampshire, and Vermont	751,500
To Cold Spring Harbor, for Delaware and Hudson Rivers	500,000
Total	1,251,500

(*g*) Schoodic or landlocked salmon.

The station at Grand Lake Stream, Maine, reported 222,000 eggs of this species as available for assignment. These were distributed as follows:

To the State commissioners	130,000
To foreign countries (in exchange)	40,000
Transferred to other United States stations	52,000
Total	222,000

(*h*) Brown trout (*Salmo fario*).

Three consignments of eggs of the brown trout (*Salmo fario*) were received from Germany.

The first consignment of 64,000 eggs from the Deutsche Fischerei-Verein arrived in very bad order and proved a total loss. The second lot of 40,000 eggs from the Deutsche Fischerei-Verein reached New York in good condition. A third lot of 50,000 eggs of this species from Max von dem Borne arrived in excellent condition. The entire number, aggregating 90,000 good eggs, were allotted as follows:

To Wytheville Station, Virginia	3,000
To Northville Station, Michigan	23,000
To Cold Spring Harbor, Long Island, New York	63,000
To James Nevin, superintendent, Madison, Wis	1,000

The subsequent disposition of these eggs and details of waters stocked will be found in the reports of stations.

(i) SHAD (*Clupea sapidissima*).

Shad for distribution were contributed as follows:

Battery Station, Susquehanna River	10,725,000
Fish Hawk Station, Delaware River	8,063,000
Central Station, Potomac River	15,531,000
Steamer Lookout	340,000
Total	34,659,000

In this distribution liberal plants of shad fry have been made in the Potomac, the Susquehanna, the Delaware, and the minor tributaries of Chesapeake and Delaware Bays.

A summary of the distribution by river basins is as follows:

Rivers and minor tributaries of Chesapeake Basin	14,137,000
The Delaware and tributaries	8,403,000
Hudson River	1,250,000
Tributaries of Narragansett Bay	850,000
Tributaries of the Albemarle	1,500,000
Streams draining into the South Atlantic	2,050,000
The Mississippi and minor tributaries of the Gulf of Mexico	4,561,000
Colorado River of the West	998,000
Snake River, Washington Territory	10,000
Willamette River, Oregon	900,000
Total*	34,659,000

* Of this number of fish which started from the stations, there perished before reaching destination, 1,861,000, as follows:

On trip to Willamette River, Oreg	850,000
On trips to Congaree and Green Rivers, S. C	575,000
On trip to Colorado River, Ariz	150,000
On trips to Fox and Illinois Rivers, Ill	96,000
On trips to Ocklockonnee and other Georgia Rivers	75,000
On trips to Blue, Smoky, and Republican Rivers, Kans	65,000
On trips to Appomattox and other Virginia Rivers	25,000
On trip to Narragansett Bay	25,000
Total	1,861,000

The attempt to acclimate the shad in the Colorado River of the West, which was begun in 1884, has been continued the present season, during which 848,000 fry were sent out by car No. 2, in charge of George H. H. Moore, and planted in good condition. Should the experiment prove successful, we may expect to see the plant of 1884 reappearing as full-grown, mature fish in the spring of 1887 or 1888.

The conditions that have determined the selection of the Colorado River of the West for this important experiment in acclimatization and afford reasonable expectation of successful results, are as follows:

The waters of the Colorado are exceptionally free from alkaline salts. The spring and summer temperature of the waters and other favorable characteristics make it probable that the young shad will find in them a congenial habitat during their sojourn in fresh waters. Great profusion of minute forms of animal life abounds in the waters. Every condition would therefore seem to be favorable to the early stages of life of the shad. If, after migrating to salt water, they do not become *wanderers*, as the shad planted in the Sacramento River have done, there is every probability that the experiment will be successful.

Since the Colorado River empties into the head of the Gulf of California, which stretches south for 700 miles towards the equator before joining the ocean, it is probable that the high temperature of the waters of its more southern portions will serve as a bar, or temperature wall, to prevent the shad from passing southward into the open ocean.

Should this anticipation be realized, the shad, when mature, must necessarily find their way back to spawning ground in the Colorado and Gila Rivers.

An unsuccessful attempt was also made the present season to stock with shad the streams of the Seattle region of Washington Territory; 900,000 vigorous fry were selected and sent out by car No. 2, in charge of Mr. Moore, one of the most experienced and careful messengers of the Commission.

The experiment was hazardous, because the number of days required for uninterrupted transit from Washington to Seattle marks the limit of time within which transportation can be safely effected. A detention of three days *en route*, caused by the washing away of bridges, resulted in almost total loss of shipment. Only 50,000 were alive on arrival at Portland, Oreg. These were deposited in the Willamette River, near that city.

A table of distribution of young shad, showing 18,871,000 planted during the season of 1885, will be found on pages 384 and 385 of the Fish Commission Bulletin for 1885. That table should be amended as follows:

Number of shad planted as given in the table	18,871,000
Planted in Delaware River by steamer Fish Hawk	8,063,000
Planted in Susquehanna River from Battery Station	5,524,000
Planted in Delaware River by steamer Lookout	340,000
Total	32,798,000

(*j*) Carp (*Cyprinus carpio*).

The total distribution for the season aggregated 348,784, as follows:

Table of German carp planted in public waters during the season of 1885-'86.

Date.	Waters stocked.	Place of deposit.	Number of fish.
Dec. 4, 1885	Acquia Creek	Bridge on Baltimore and Potomac Railroad, Virginia.	6,250
Dec. 20, 1885	Arkansas River	Granada, Colo	5,000
Dec. 23, 1885	Banister River	Railroad crossing near Lynchburg, Va.	3,000
Dec. 7, 1885	Bayou La Fourche	La Fourche, La	1,000
Jan. 5, 1886	Bayou Macon	Between Delta and Shreveport, La	1,000
Dec. 30, 1885	Big Muddy River	Wood Lawn, Ill	400
Dec. 10, 1885	Brandywine Creek	Wilmington, Del	500
Oct. 27, 1885	Bungay River	Attleborough, Mass	200
Dec. 10, 1885	Christiana Creek	Wilmington, Del	500
Jan. 5, 1886	Bœuf River	Between Delta and Shreveport, La	1,000
Dec. 31, 1885	Clear Lake	Riverton, Ill	1,000
Dec. 23, 1885	Dan River	Danville, Va	6,000
Dec. 10, 1885	Delaware River	Wilmington, Del	500
Jan. 2, 1886	Des Plaines River	Near Naperville, Ill	200
Nov. 28, 1885	Tributary of Forked Deer River	Near Dyersburgh, Tenn	1,000
Nov. 30, 1885	Tributary of Forked Deer River	Near Fowlkes, Tenn	1,000
Jan. 2, 1886	Fox River	Near Aurora, Ill	1,000
Jan. 5, 1886	Grassy Lake, Richland County	Between Delta and Shreveport, La	1,000
Dec. 21, 1885	Great Pedee River	Near Society Hill, S. C	600
Jan. 1, 1886	Illinois River	La Salle, Ill	3,000
Nov. 24, 1885	Ivy Creek	Near Charlottesville, Va	400
Jan. 2, 1886	Kankakee River	Kankakee, Ill	1,000
Dec. 5, 1885	Lakes near Jacksonville	Near Jacksonville, Fla	600
Jan. 2, 1886	Lakes in South Park	Chicago, Ill	1,050
Jan. 2, 1886	Lakes in Lincoln Park,	Chicago, Ill	1,600
Dec. 8, 1885	Lake in Alabama	On Atlanta and West Point Railroad	500
Nov. 4, 1885	Lake Beauty, Murray County	Near Slayton, Minn	500
Dec. 30, 1885	Lake Cooper	Pekin, Ill	100
Jan. 5, 1886	Lake One	Between Delta and Shreveport, La	1,000
Dec. 30, 1885	Lanesville Lake	Lanesville, Ill	800
Nov. 28, 1885	Little River	Intersection of Richmond, Fredericksburg and Potomac Railroad, Virginia.	5,000
Jan. 1, 1886	Little Vermilion River	Mendota, Ill	1,000
Dec. 30, 1885	Little Wabash River	Louisville, Ill	200
Dec. 30, 1885	Little Wabash River	Mill Shoals, Ill	400
Dec. 8, 1885	Mahoning River	Near Youngstown, Ohio	3,000
Nov. 27, 1885	Mattapony River	Milford, Va	8,000
Mar. 26, 1886	Muskingum River	Zanesville, Ohio	3,750
Nov. 28, 1885	North Anna River	Intersection of Richmond, Fredericksburg and Potomac Railroad, Virginia.	7,000
Dec. 30, 1885	Kaskaskia River	Vandalia, Ill	1,000
Dec. 30, 1885	Kaskaskia River	Carlyle, Ill	400
Dec. 4, 1885	Occoquan River	Wood Bridge, Va	7,000
Dec. 23, 1885	Otter River	Railroad crossing near Lynchburg, Va.	5,000
Jan. 5, 1886	Washita River	Between Delta and Shreveport, La	2,000
Jan. 5, 1886	Pearl River	Jackson, Miss	5,000
Jan. 16, 1886	Ponds of railroad	Along line of Vandalia Railroad	2,520
Dec. 4, 1885	Potomac River	On line of Baltimore and Potomac Railroad, Virginia.	5,500
Dec. 4, 1885	Quantico Creek	Bridge on Baltimore and Potomac Railroad, Virginia.	6,250
Dec. 10, 1885	Red River	Shreveport, La	2,500
Dec. 20, 1885	Red River	Fulton, Ark	3,200
Dec. 21, 1885	Rio Grande River	Albuquerque, N. Mex	6,000
Nov. 24, 1885	Rivanna River	Near Charlottesville, Va	1,600
Nov. 15, 1885	Rockfish Creek	Rockfish Depot, Va	200
Jan. 1, 1886	Rock River	Dixon, Ill	1,000
Dec. 30, 1885	Saline River	Equality, Ill	400
Dec. 30, 1885	Sangamon River	Riverton, Ill	1,000
Dec. 12, 1885	San Marcos River	San Marcos, Tex	5,050
Dec. 11, 1885	Satilla River	Near Way Cross, Ga	2,400
Dec. 10, 1885	Shellpot Creek	Wilmington, Del	500
Nov. 28, 1885	South Anna River	Intersection of Richmond, Fredericksburg and Potomac Railroad, Virginia.	5,000
Dec. 23, 1885	Staunton River	Near Lynchburg, Va	6,000
Nov. 17, 1885	Susquehanna River	Battery Station, Md	20,000
Jan. 5, 1886	Tensas River	Between Delta and Shreveport, La	1,000
1885	Tewksbury Reservoir	Winchester, Mass	600
Dec. 30, 1885	Railroad water-tank	Clinton, Ill	200
Total			161,370

Summary of carp distributed to private applicants from October 6, 1885, *to March* 20, 1886.

Date.	State.	Point of distribution.	Number of counties.	Number of applicants.	Number of fish.
1885.					
Dec. 1	Alabama	Montgomery, Ala	42	164	4,475
Dec. 21	Arizona	Albuquerque, N. Mex	6	8	695
Dec. 17	Arkansas	Saint Louis, Mo	32	88	2,260
Nov. 16	Colorado	Denver, Colo	15	25	550
Oct. 27	Connecticut	Boston, Mass	7	18	400
Nov. 6	Dakota	Bismarck, Dak	18	26	822
Nov. 2	Delaware	Wilmington, Del	3	31	2,124
(*)	District of Columbia	Washington, D. C	1	14	301
Dec. 5	Florida	Jacksonville, Fla	13	38	1,475
Nov. 28	Georgia	Atlanta, Ga	89	460	12,605
Nov. 11	Idaho	Ogden, Utah	10	31	686
Nov. 15	Illinois	Quincy, Ill	84	384	15,699
Nov. 14	Indiana	Indianapolis, Ind	70	240	8,417
Dec. 16	Indian Territory	Dallas, Tex	2	2	50
Nov. 2	Iowa	Cedar Rapids, Iowa	79	383	11,221
Oct. 27	Kansas	Kansas City, Mo	76	290	6,015
Nov. 28	Kentucky	Lexington, Ky	35	108	3,630
Dec. 7	Louisiana	New Orleans, La	19	31	820
Oct. 27	Maine	Boston, Mass	6	7	145
(*)	Maryland	Washington, D. C	12	42	2,075
Oct. 27	Massachusetts	Boston, Mass	13	49	1,990
Nov. 16	Michigan	Northville, Mich	51	177	3,801
Nov. 4	Minnesota	Saint Paul, Minn	8	11	1,425
Dec. 3	Mississippi	Jackson, Miss	33	117	3,030
Dec. 19	Missouri	Saint Louis, Mo	19	37	885
Nov. 8	Montana	Helena, Mont	8	19	520
Nov. 3	Nebraska	Omaha, Nebr	21	30	880
Nov. 10	Nevada	Ogden, Utah	10	15	529
Oct. 27	New Hampshire	Boston, Mass	3	3	75
Oct. 30	New Jersey	Jersey City, N. J	21	78	3,947
Dec. 21	New Mexico	Albuquerque, N. Mex	12	44	1,245
Oct. 30	New York	Jersey City, N. J	47	298	9,011
Dec. 7	North Carolina	Raleigh, N. C	54	341	8,825
Nov. 13	Ohio	Columbus, Ohio	73	276	6,482
Nov. 12	Oregon	Portland, Oreg	19	185	3,921
(*)	Pennsylvania	Washington, D. C	61	609	20,348
Oct. 27	Rhode Island	Boston, Mass	2	2	280
Nov. 24	South Carolina	Columbia, S. C	30	249	6,624
Dec. 1	Tennessee	Memphis, Tenn	51	366	8,005
Dec. 16	Texas	Dallas, Tex	42	86	2,682
Nov. 11	Utah	Ogden, Utah	19	283	5,855
Oct. 27	Vermont	Boston, Mass	8	19	5,380
(*)	Virginia	Washington, D. C	66	351	7,756
Nov. 10	Washington	Walla Walla, Wash	20	157	3,498
(*)	West Virginia	Washington, D. C	19	54	1,600
Nov. 4	Wisconsin	Saint Paul, Minn	16	23	495
Nov. 5	Wyoming	Laramie City, Wyo	3	3	3,060
Dec. 23	Mexico	El Paso, Tex		1	800
	Total		1,348	6,273	187,414

* October 6, 1885, to March 20, 1886.

To individual applicants for pond culture	187,414
To public waters	161,370
The number of individual applicants supplied was	6,273

The distribution was general, including 309 Congressional districts and 1,348 counties. The distributions to public waters embrace the principal river basins of the Middle and South Atlantic and Gulf slopes.

(*k*) Common and Japanese goldfish (*Carassius auratus*).

The number of this fish produced at the U. S. Fish Commission ponds in Washington each season is entirely insufficient to meet the eager demand for fish for aquaria, fountains, and ornamental lakes. The fish being purely an ornamental species, of no value for food, no special ef-

fort has been made to increase the supply. The number distributed in 1885 was 4,344 to 572 applicants.

Summary of goldfish distributed in the season of 1885–'86.

State.	Number of applicants.	Number of fish.	State.	Number of applicants.	Number of fish.
Alabama	11	170	Minnesota	5	138
Arizona	4	24	Missouri	1	6
Arkansas	1	4	Mississippi	2	14
Colorado	2	12	Nebraska	4	20
Dakota	2	12	New Jersey	7	42
Delaware	4	84	New York	6	48
District of Columbia	338	1,899	North Carolina	3	14
Florida	7	41	Ohio	11	98
Georgia	10	119	Pennsylvania	18	374
Illinois	8	154	South Carolina	3	58
Indiana	6	50	Tennessee	10	60
Iowa	8	199	Texas	10	83
Kansas	1	10	Utah	8	44
Kentucky	2	18	Virginia	49	251
Louisiana	4	21	West Virginia	1	7
Maryland	4	84	Wyoming	1	4
Massachusetts	7	92			
Michigan	14	90	Total	572	4,344

(*l*) LITTLE ROUND CLAM (*Tapes staminea*).

A successful effort was made to transfer several hundreds of this valuable west-coast mollusk from Puget Sound, Washington Territory, to the waters of Vineyard Sound, off the coast of Massachusetts. The conduct of the experiment was intrusted to Mr. George H. H. Moore, in charge of car No. 2. As the necessary conditions for success in transportation had not been ascertained, the entire arrangement was left to his discretion. The methods employed, the difficulties encountered, and the final success attained are detailed in his report, dated Washington, June 30, 1885, the important items of which are as follows:

"*Sunday, June* 14.—After much trouble and the promise of $2 per sack (the usual price being about $1.50 per sack), I engaged 20 sacks of clams, to be delivered at car by Wednesday noon. I also engaged enough rock weed to pack over the clams.

"*Tuesday, June* 16.—Finished getting sand in tanks this p. m. One of the clam gatherers, from whom I engaged 10 sacks of clams, returned with 1 sack. Had them tied up and put overboard, so as to keep in good condition.

"*Wednesday, June* 17.—The other 10 sacks of clams arrived this a. m. After consultation with those that make a business of gathering clams, I concluded it would be best to pack them in sand, with mouth up, then cover with about 2 inches of sand, and put the rock weed on top of this, then, by means of a sprinkling-can, keep them moistened with the salt water. After selecting the smallest of the clams, had them packed as above described. Took on 30 cans of salt water. Estimated the number of clams in tanks at 6,000.

"*Thursday, June* 18.—Left Tacoma at 5.25 a. m. Put one-half ton of ice in tanks.

"*Sunday, June* 21.—Had clams in tanks taken out. Find they are not looking well. Concluded to have them taken out of sand and placed on top of sand, with mouths up, then covered with the rock weed.

"*Monday, June* 22.—Had the other side unpacked and looked over. They seem to be doing tolerably well. In repacking I find the estimate as to the number in tanks was too high; from 4,000 to 4,500 is nearer the number.

"*Tuesday, June* 23.—Clams packed in rock weed are in very bad condition; those packed in sand also are in poor condition. Concluded to put them all in cans and cover with salt water.

"*Wednesday, June* 24.—In changing water on clams to-day I find that they are in bad condition, and the prospect not encouraging. Had them looked over every few hours to prevent the dead ones from contaminating the water.

"*Thursday, June* 25.—Clams are looking better this evening. Arrived Boston 9.45 p. m. Had car transferred to depot Old Colony Railroad; sent car to dock; got some fresh water for the clams and had it put on them.

"*Friday, June* 26.—Had clams put in baggage car; looking very well. Arrived at Wood's Holl 11.40 a. m.; had clams transferred to station U. S. Fish Commission. These were put out in sand on the beach and counted, and 768 looked as if they were alive and in good condition, a good many of them being lively enough to cover themselves before I left, at 4.10 p. m."

NEW STATION NEEDED.

The attention of the Commissioner has been drawn to the increasing demand for trout for stocking streams in the Trans-Mississippi and Rocky Mountain region. It is impracticable to provide satisfactorily for these requests to such extent as the importance of the work demands by sending the fish from existing Eastern stations.

The necessity for the establishment of a breeding and rearing station for the *Salmonidæ* at some central point in the Rocky Mountain region grows each year more apparent. At such station we could provide for the hatching, rearing, and distribution of desirable species of the *Salmonidæ*, at a reasonable cost, and at the same time arrange for the collection of the eggs of the native Rocky Mountain trout (*Salmo purpuratus*) for the stocking of Eastern waters. This species, though similar to the rainbow trout in many respects, has a much wider geographical and climatic range, and would therefore seem better adapted for general distribution.

WASHINGTON, D. C., *December* 30, 1886.

116.—REPORT ON DISTRIBUTION OF FISH AND EGGS FROM NORTHVILLE AND ALPENA STATIONS FOR SEASON OF 1885-'86.

By FRANK N. CLARK.

The following tables and statements contain some details regarding the distribution of eggs and fry from these stations which are not included in the report of operations at Northville and Alpena in the Fish Commission Report for 1885, beginning at page 121.

WHITEFISH (*Coregonus clupeiformis*).

Shipments of whitefish eggs from Northville Station, season of 1885-'86.

Date.	Destination.	Address.	Shipments.	No. of eggs.
1885-'86.				
Nov. 20—Jan. 8.	Hatchery of Pennsylvania Fish Commission.	Erie, Pa	5	*16,500,000
Dec. 21	E. B. Hodge, for New Hampshire Fish Commission.	Plymouth, N. H.	1	†500,000
Dec. 21	Otto Gramm, for Wyoming Fish Commission.	Laramie City, Wyo	1	‡500,000
Jan. 1	Central Station, United States Fish Commission.	Washington, D. C.	1	†2,000,000
Jan. 1	Druid Hill Hatchery, Maryland Fish Commission.	Baltimore, Md	1	†500,000
Jan. 5, 23	W. Oldham Chambers, for National Fish Culture Association.	South Kensington, London, England.	2	§2,000,000
Jan. 5, 20	Herr von Behr, for Deutsche Fischerei-Verein	Geestemünde, Germany	2	§2,000,000
Jan. 5	Swiss Government	Berne, Switzerland	1	§1,000,000
Jan. 11	E. G. Shortlidge, for private hatchery	Wilmington, Del.	1	‖800,000
Jan. 18—Feb. 4.	R. O. Sweeny, for Minnesota Fish Commission.	Saint Paul, Minn	7	†15,000,000
Feb. 5	Sir Julius Vogel, care of C. R. Buckland, San Francisco.	Wellington, New Zealand.	1	1,000,000
Mar. 6	Herr von Behr, care of E. G. Blackford, New York.	Geestemünde, Germany	1	†1,000,000
	Total		24	42,800,000

* Reached destination in good condition; hatched with moderate loss, so that 14,625,000 were planted in Lake Erie between March 12 and 31.
† Reached destination in good condition.
‡ Reached destination in good condition; hatched with loss of 10 per cent; planted 400,000 in Wyoming lakes, and retained 50,000 at hatchery.
§ Reached Cold Spring Harbor in good condition, and were reshipped by Fred Mather.
‖ Reached destination in good condition; hatched with loss of 3 per cent eggs and 500 fry; planted 775,300 in rivers and bay of Delaware.

Summary of fry from Northville and Alpena planted in the Great Lakes, spring of 1886.

Lake Huron	30,000,000
Lake Michigan	29,000,000
Lake Erie	15,000,000
Lake Ontario	12,000,000
Lake Superior	6,000,000
Total	*92,000,000

* About 5 per cent were lost in transit; really about 87,000,000 live fry were planted.

Record of trips made by Fish Commission cars with whitefish fry from Northville Station in the spring of 1886.

CAR NO. 2.

Date of loading car.	Destination.	Lake.	Railroads traversed.*	Hours in transit.	Temperature of water in cans on arrival.	Temperature of water in lake.	Percentage of loss.	No. of fry transported.†
1886.					°	°		
Mar. 29	Oswego, N. Y	Ontario	Michigan Central; and Rome, Watertown and Ogdensburg	28	40	38	5	3, 000, 000
Apr. 1	Put-in-Bay, Ohio	Erie	Lake Shore and Michigan Southern; and Baltimore and Ohio	19	39	38	....	3, 000, 000
3	Fort Gratiot, Mich	Huron	Chicago and Grand Trunk	17	40	34	....	3, 000, 000
5	Sodus Bay, N. Y	Ontario	Michigan Central; and Rome, Watertown and Ogdensburg	27	40	....	3	3, 000, 000
8	Saint Joseph, Mich	Michigan	Michigan Central; and Chicago and West Michigan	29	40	34	4	3, 000, 000
12	Port Clinton, Ohio	Erie	Lake Shore and Michigan Southern	15	43	38	5	3, 000, 000
14	Milwaukee, Wis	Michigan	Chicago and Grand Trunk; and Chicago and Northwestern	31	36	38	2½	3, 000, 000
18	Chaumont Bay, N. Y	Ontario	Great Western; and Rome, Watertown and Ogdensburg	50	43	48	5	1, 500, 000
18	Sackett's Harbor, N. Y	...do	......do	63	43	56	5	1, 500, 000
			Total by car No. 2	....	....	....	....	24, 000, 000

CAR NO. 3.

Date of loading car.	Destination.	Lake.	Railroads traversed.*	Hours in transit.	Temperature of water in cans on arrival.	Temperature of water in lake.	Percentage of loss.	No. of fry transported.†
Mar. 23	Manistee, Mich	Michigan	....	22	....	33½	0	3, 000, 000
26	North Bass Island, Ohio	Erie	Lake Shore and Michigan Southern	30	....	35	5	3, 000, 000
30	Grand Haven, Mich	Michigan	Detroit, Grand Haven and Milwaukee	17	....	35½	5	3, 000, 000
Apr. 2	Charlotte, N. Y	Ontario	Michigan Central; and Rome, Watertown and Ogdensburg	52	....	35	6	3, 000, 000
7	Catawba Island, Ohio	Erie	Lake Shore and Michigan Southern	26	....	35	24	3, 000, 000
9	Monroe, Mich	.. do	....	8	....	40	0	3, 000, 000
11	Michigan City, Ind	Michigan	Michigan Central	24	....	40	Small	3, 000, 000
11	Waukegan, Ill	...do	......do	92	....	40	...do	‡3, 000, 000
16	Manitowoc, Wis	.. do	Michigan Central; Chicago and Northwestern; Milwaukee, Lake Shore and Western.	45	....	35	11	3, 000, 000
21	Escanaba, Mich	...do	Michigan Central; and Chicago and Northwestern	43	35	34	....	1, 000, 000
28	Marquette, Mich	Superior	Detroit, Mackinaw and Marquette	....	....	35	0	§3, 000, 000
			Total by car No. 3	....	....	....	....	31, 000, 000
	Total by both cars	....	....	....	....	....	....	55, 000, 000

*The Flint and Pere Marquette Railroad was traversed on each of these trips (except the last by car No. 3), Northville being situated on that road. All furnished free transportation except the Chicago and Northwestern.

†The number of fish carried by car No. 2 was usually contained in 72 cans, holding 7½ gallons each.

‡Started as eggs, but hatched at Chicago.

§From the Alpena hatchery, all the others being from Northville.

Additional shipments of whitefish fry from Alpena Station, spring of 1886.*

Date.	Place.	Lake.	No. of fry.
1886.			
Apr. 13	L'Anse, Mich	Superior	3,000,000
18	Epoufette, Mich	Michigan	1,000,000
20	Thompson, Mich	....do	3,000,000
29	Thunder Bay, Mich	Huron	3,000,000
30	Alcona, Mich	....do	3,000,000
May 1	Scarecrow Island, Mich	....do	3,000,000
2	Thunder Bay, Mich	....do	3,000,000
3	Saint Ignace, Mich	....do	3,000,000
4	Scarecrow Island, Mich	....do	3,000,000
6	Miller's Point, Mich	....do	3,000,000
6	Sturgeon Point, Mich	... do	3,000,000
8	Hammond's Bay, Mich	... do	3,000,000
12	Epoufette, Mich	Michigan	3,000,000
	Total		37,000,000

* These shipments were all made by boat direct from Alpena.

Total distributed from Northville *52,000,000

Total distributed from Alpena 40,000,000

BROOK TROUT (*Salvelinus fontinalis*).

Shipments of brook trout eggs from Northville Station during the season of 1885–'86.

Date.	Consignee.	Number of eggs.
1885–'86.		
Dec. 17	George A. Seagle, for hatchery at Wytheville, Va	*50,000
Jan. 22	A. W. Aldrich, for Iowa commission, Anamosa, Iowa	†10,000
22	B. F. Ferris, for Cold Creek Trout Club, Castalia, Ohio	‡5,000
22	John H. Rockland, for Rhode Island commission, Rockland, R. I	10,000
22	E. B. Hodge, Plymouth, N. H., for Hiram A. Cutting, Lunenburgh, Vt	10,000
22	W. I. Coon, Millville Depot, Pa., for Frishmuth Bro. & Co., Philadelphia, Pa	§15,000
23	W. Oldham Chambers, for the National Fish Culture Association, London, England	‖10,000
27	Herr von Behr, for the Deutsche Fischerei-Verein, Berlin, Germany	‖25,000
27	Government of Switzerland	‖10,000
	Total	¶145,000

* Reached destination in very good condition. Loss of eggs and fry before planting was 7,518, leaving 42,482 planted in ponds at station.
† Reached destination in good condition.
‡ Reached destination in excellent condition. Fry planted with loss of 5 per cent.
§ Reached destination in good condition. Loss of eggs and fry before planting was 4,863, leaving 10,137 planted in Blooming Grove and Shohola Creeks, Pike County, Pennsylvania.
‖ Reshipped from Cold Spring Harbor by Fred Mather.
¶ Also 25,000 eggs were exchanged for an equal number from the State fish commission at Paris.

During April and May 4,000 brook trout fry were shipped away to the following persons:

W. S. Woodward, Plymouth, Ind 1,000
Rev. Father Maher, Notre Dame, Ind 1,000
J. S. Little, Niles, Mich 1,000
C. H. Bates, Lake Station, Mich., for Flint and Pere Marquette Railroad 1,000

Total 4,000

* Of these, 3,000,000 left Northville as eggs, but were hatched at Chicago and then planted.

RAINBOW TROUT (*Salmo irideus*).

Of the 167,000 rainbow trout eggs taken, only 5,000 were sent away, as follows:

B. F. Ferris, Castalia, Ohio	3,000
S. B. Smith, Zanesville, Ohio	2,000

During the season 3,364 yearling and two-year-old rainbow trout were distributed, partly by car No. 2, and the remainder by special messengers. They were delivered to 7 persons and 2 railroad companies, for stocking streams and lakes, as indicated in the following statement:

Samuel E. Williams, La Porte, Ind	390
A. W. Hendry, Angola, Ind	525
Rev. Father Maher, Notre Dame, Ind	125
Philip Smethurst, Warren, Ind	75
C. H. Dougherty, Fremont, Ind	774
M. P. Hammond, Howard, Ohio	75
J. L. Delano, Mount Vernon, Ohio	100
Flint and Pere Marquette Railroad	500
Grand Rapids and Indiana Railroad	800
Total	3,364

LAKE TROUT (*Salvelinus namaycush.*)

Shipments of lake trout eggs from Northville Station during the season of 1885–'86.

Date.		Consignee.	No. of eggs.
1885–'86.			
Nov.	—	Central Station, Washington, D. C	*100,000
	—	W. M. Cary, for Nevada commission, Carson City, Nev	†25,000
	19	Charles G. Atkins, Bucksport, Me	‡50,000
	19	Thomas J. and Hardy Dean, Nesbitt, Miss	8,000
	20	John Gay, for Pennsylvania commission, Erie, Pa	25,000
Dec.	15	Fred Mather, Cold Spring Harbor, N. Y	*150,000
	15	Charles G. Atkins, Bucksport, Me	§100,000
	22	W. M. Cary, for Nevada commission, Carson City, Nev	‖75,000
	22	Dr. Charles F. Hoeing, Jersey City, N. J	10,000
	22	G. W. Delawder, for Druid Hill hatchery, Oakland, Md	*25,000
	22	B. E. B. Kennedy, for Nebraska commission, Omaha, Nebr	*50,000
	22	John Pierce, for Colorado commission, Denver, Colo	*10,000
	23	George A. Seagle, for hatchery at Wytheville, Va	¶100,000
	23	E. B. Hodge, for New Hampshire commission, Plymouth, N. H	*50,000
	24	Hiram A. Cutting, South Lancaster, N. H	*40,000
Jan.	1	Thomas J. and Hardy Dean, Nesbitt, Miss	*8,000
	5	W. Oldham Chambers, for the National Fish Culture Association, London, England	**50,000
	5	Herr von Behr, for the Deutsche Fischerei-Verein, Berlin, Germany	**50,000
	5	Government of Switzerland	**50,000
	9	Dr. E. G. Shortlidge, Wilmington, Del	††30,000
	18	E. Chazari, Mexico, Mexico	‡‡25,000
		Total	1,031,000

* Reached destination in good condition.

† Reached destination in poor condition.

‡ Total loss. Storm-bound 5 days on the way.

§ Reached destination in good condition. From this shipment 73,802 fry were planted at Orland, Me., 2,500 at Phippsburgh, Me., and 12,700 kept at the hatchery, the rest being lost.

‖ Reached destination in good condition. From this shipment 59,000 fry were deposited in Carson, Walker, and Humboldt Rivers, and in the tributaries of Lake Tahoe.

¶ Reached destination in very good condition. Only 74,060 were reported as received. Subsequent losses were heavy, only 11,450 living till released in ponds at station.

** Reshipped from Cold Spring Harbor, N. Y., by Fred Mather.

†† Reached destination in good condition. Subsequent losses were heavy, leaving only 8,600 to be planted in tributaries of the Delaware.

‡‡ Reached destination in poor condition, owing to the long distance and high temperature. Only about 2,200 remained for cultivation and propagation.

Shipments of lake trout fry from Northville Station during the spring of 1886.

Date.	Consignee.	No. of fry.
1886.		
Apr. 15	John Stevenson, Cedarville, Ohio	2,500
22	E. R. Aldrich, Saline, Mich	*2,500
24	A. W. Hendry, Angola, Ind	†5,000
24	Joseph Butler, Angola, Ind	†2,000
24	W. W. Snyder, Angola, Ind	†2,500
24	Lawrence Yates, Angola, Ind	†4,500
24	Rev. Father Maher, Notre Dame, Ind	†2,000
27	Flint and Pere Marquette Railroad	‡10,000
May 1	J. J. Shaver, Laingsburgh, Mich	§10,000
12	C. H. Andrews, Youngstown, Ohio	‖5,000
27	C. H. Dougherty, Fremont, Ind	¶29,500
	Total	75,500

* Shipped by car No. 3.
† Shipped by car No. 2.
‡ Planted in Arnold's Lake, Clare County, Michigan.
§ Planted in Round Lake, Clinton County, Michigan.
‖ Reached destination in good condition.
¶ Planted in Green, Walden, Fish, Clear, George, and Pleasant Lakes, Indiana.

LANDLOCKED SALMON (*Salmo salar* var. *sebago*).

On March 19, 1886, a case containing 29,000 eggs was received from the station at Grand Lake Stream, Maine. These were hatched with a loss of only 575 dead eggs. Of the resulting young fish, 22,000 fry were successfully shipped and planted as follows:

Date.	Destination.	No. of fry.
Apr. 27	Lake in Clare County, Michigan	10,000
May 15	Rapid River, Kalkaska and Antrim Counties, Michigan	12,000

NORTHVILLE, MICH., *August* 14, 1886.

117.—SALMON STATISTICS ON THE PACIFIC COAST FOR THE SEASONS OF 1884, 1885, AND 1886.

The following tables have been prepared from salmon statistics issued by the firm of Field & Stone, brokers, of San Francisco, Cal. Other figures and accounts, covering more or less closely the same ground, may be found on pages 90, 139, 288, and 313, of this volume.

TABLE I.—*Shipments of cases of packed salmon to Australia and New Zealand.*

Where from.	1884.	1885.	1886.
San Francisco, by sail and steam	88,406	61,135	70,874

TABLE II.—*Shipments of cases of packed salmon to Great Britain.*

Where from.	1884.	1885.	1886.
Columbia River	315,916	216,940	157,072
San Francisco	36,522	126,364	100,322
British Columbia	86,075	58,503	88,606
Total*	438,513	401,807	346,000

* Of these amounts there were lost at sea, in 1884, 64,694 cases; in 1885, 37,392 cases.

TABLE III.—*Shipments of cases of packed salmon to the Eastern States and Canada.*

Where from.	1884.	1885.	1886.
San Francisco, Portland, and Victoria, by rail	320,524	326,798	434,809
San Francisco, by sea	5,000	4,500	28,262
Portland, by sea	29,654	39,175	....
Total	355,178	370,473	463,071

TABLE IV.—*Summary of shipments, local consumption, &c.*

How used.	1884.	1885.	1886.
	Cases.	*Cases.*	*Cases.*
Shipments to Great Britain *	438,513	401,807	346,000
Shipments to Eastern States and Canada	355,178	370,473	463,071
Shipments to Australia and New Zealand	88,406	61,135	70,874
Shipments to other Pacific ports (China, Japan, &c.)	15,500	12,250	13,970
Local consumption (estimated)	25,000	30,000	30,500
Stock remaining over to next year	53,500	33,050	41,989
Total	976,097	908,715	†966,404

* These shipments include the losses at sea—1884, 64,694; 1885, 37,392.
† This amount consists of the pack of 1886, as shown in Table V (933,354), plus the 1885 stock remaining over (33,050).

TABLE V.—*Salmon packed on the Pacific coast.*

Locality.	1884.*	1885.	1886.
	Cases.	*Cases.*	*Cases.*
Columbia River, Oregon and Washington	629,500	553,750	479,250
Sacramento River, California	102,000	48,500	39,300
Rogue River, Oregon	12,300	9,100	12,100
Eel River, California	8,200	5,750	12,500
Coquille River, Oregon	7,300	3,750	8,300
Smith's River, Oregon	5,500	1,550	3,200
Umpqua River, Oregon	3,700	10,500	18,600
Siuslaw River, Oregon	....	....	1,500
Tillamook River, Oregon	4,350	7,800	31,800
Chehalis River, Washington	....	8,200	....
Puget Sound, Washington	....	5,100	10,800
Gray's Harbor, Washington	....	....	18,700
Shoalwater Bay, Washington	....	....	13,600
Alaska	54,000	74,850	120,700
Fraser River, British Columbia	38,380	76,230	103,060
Skeena River, British Columbia	61,715	24,635	35,556
Naas River, British Columbia	8,405	....	....
Smith's Inlet, British Columbia	3,365	....	......
Rivers Inlet and northern bays of British Columbia	20,380	....	24,388
Alert Bay, British Columbia	6,700	6,000	....
Unknown	19,500	....	....
Total	985,295	835,715	933,354

* The season of 1884 is to be understood as extending from April, 1884, to March 14, 1885; that of 1885 as from March 14, 1885, to January 25, 1886; and that of 1886 as from January 25, 1886, to January 25, 1887.

Vol. VI, No. 26. Washington, D. C. Feb. 26, 1887.

118.—NOTES UPON FISH AND THE FISHERIES.

[Extracted from the official correspondence and compiled by the editor.]

PURIFYING WATER IN GLASS VESSELS AND AQUARIUMS.—To purify water in glass vessels and aquariums it is recommended to add to every 100 grams of water 4 drops of a solution of 1 gram of salicylic acid in 300 grams of water. It is said that thereby the water may be kept fresh for three months without being renewed. [From the *Norsk Fiskeritidende*, Bergen, Norway, October, 1886.]

CARP IN THE OHIO RIVER.—Mr. Hugo Mulertt, writing from Cincinnati, Ohio, on December 11, 1886, says: "This morning I noticed for the first time German carp in our public market. They were scale carp, and were caught in the Ohio River, some specimens weighing as much as 11½ pounds. They readily sold at nine cents a pound. The fishermen inform me that of late they have frequently taken German carp in the Ohio."

CARP IN ILLINOIS.—Fish Commissioner S. P. Bartlett recently sent to his colleague, Mr. N. K. Fairbank, a carp weighing over 15 pounds, which was taken with another of about the same size (each being a little over 30 inches in length) in the Illinois River. No carp have been placed in that stream by the commissioners, and these fish probably escaped from a private pond when young and grew up in the river. This one could not have been over five years old, as none were distributed prior to 1881. Mr. Fairbank had the fish baked at the Chicago Club, and invited half a dozen epicures to the feast. Though not so firm or flaky as the whitefish the flavor was good, and those who partook of it pronounced it an excellent edible fish. There are about 6,000 private carp ponds in the State, and the fish are becoming very popular, farmers raising thousands of them with little or no trouble. Both old and young carp are frequently taken from the Mississippi River near Quincy, Ill., being the results of several accidental stockings of this river and its tributaries. [From the Chicago Tribune, November 28, 1886.]

RECEIPT FOR COOKING CARP.—Mr. N. T. Haverfield, writing from Cadiz, Ohio, January 29, 1887, gives the following receipt for cooking and serving carp, which has been used and much liked by him:

Take a four or five pound fish, clean well, split open down the back, leaving the head on; salt down in water for two or three hours; then take out, wash clean, and put in earthen vessel or crock, with vinegar enough (not too strong) to cover; and spice to suit taste, over night. Bake the next day and then set it away to cool. Serve cold with other meats cut out in slices. It is very nice for lunch.

VITALITY OF CARP.—A small lot of carp was sent to C. E. Jones, Carysbrook, Va., leaving Washington on the night of November 29, 1886, at 10 p. m. These carp were on the way over five days, they having been delayed in Columbia. Mr. Jones, who lives 12 miles from that point, on the Rivanna River, depended on the captain of a boat running between those points to bring the carp. The captain failed for several days to do so, and the carp lay over in the express room without a change of water. After this delay they were brought up the river in an open boat 12 miles with the thermometer at 23° Fahrenheit. When Mr. Jones opened the bucket, December 4, he thought the fish were all dead, as there were no signs of life and only a pint of water, the rest having been turned to ice; but noticing a slight movement of the gills, he transferred the fish to tepid water and in thirty minutes they were all lively. He then kept them over Sunday in the house, during which time none died or showed any injurious effects. This display of vitality is doubtless due to the cold weather at the time the fish were shipped and during their stay in Columbia.

LIABILITY OF YOUNG CARP TO STARVE.—Mr. O. P. Anderson, of Osceola, Iowa, writing November 9, 1886, says that during the past summer his thirty-two spawning fish produced millions of eggs which hatched well, but the young perished in less than three days after hatching. He wrote to inquire the cause of this. His letter was referred to Dr. Hessel, superintendent of the carp ponds, who, in reply thereto, made the following statement:

I do not think that Mr. Anderson's young fish died on account of any injurious ingredients in the soil or water. Probably the lack of natural food in the ponds killed them. Last summer was a cool one, the mean temperature of the month of May being 64° at the Washington carp ponds. The low temperature prevented the development of all kinds of infusoria, which are the natural and best food for young fish.

What Mr. Anderson might have done was to feed his small fish with uncooked brain from any kind of mammal. It should be mashed through a sieve to make it fine. A quarter of a pound per day is sufficient for 100,000 young fish when from two to six days old. When they get older, raw liver may be given in the same manner, one-half to three-fourths of a pound per day. The feeding should occur in the forenoon about 8 or 9 o'clock, and not in the afternoon or evening.

Common flour is also very good food for small fish, taking one-fourth pound of flour to three gallons of water, and boiling it to make a very thin paste. This, like any other kind of food for little fishes, must be given in the very smallest particles. Blood contains a large percentage of albumen, but must not be given to very young fry. The feeding grounds should be arranged by fastening pieces of old boards on the ground in shallow water so that they will be a few inches under the surface of the water. Fresh boards will not answer for this purpose.

WATER-BUGS SUPPOSED TO INJURE CARP.—Mr. J. P. Quarles, of Farmington, Wash., writing on December 29, 1886, says, in substance:

When draining my carp pond, in November last, I found a few carp whose tail fins seemed to have been nipped off, the places being covered with a fungous growth resembling a bunch of cotton, while one or two had one eye gone, and in its place was the same fungous growth. In the water there are many bugs of three kinds: (1) This is about $1\frac{3}{4}$ inches long by three-fourths inch wide, with a spare head like a beetle's, and with long black wings, which are hard. (2) This has a round body, with a head something like that of No. 1. (3) This is smaller, being about three-fourths inch long by one-half wide, and very numerous. It seems black in the water, but when out of water is black-and-white spotted. It floats around the edges, but when alarmed dives to the bottom. In the air it flies rapidly. When pressed with the hand it either bites or stings, which is very painful. I think these bugs are what injure the fish, but would like some information.

CARP MULLETS CULTIVATED IN NORTH CAROLINA.—Mr. W. R. Fraley, of Salisbury, N. C., writing on December 14, 1886, speaks of carp mullets,* which he has cultivated with considerable success, substantially as follows:

For several years I cultivated carp mullets in one of my ponds with good success. These fish bred well, and were the only fish, in fact, that would do well in my ponds. On receiving my first lot of carp I dispensed with the mullets for a time, but after a few years resumed their cultivation. Though they were placed in a separate pond, a freshet carried some of the carp into this pond, and I allowed the two kinds of fish to remain together.

This seems to have been very disastrous for the mullets; for though they increased for a while, yet last March, when I put in a net to catch some, I found them in very poor condition. In November, 1886, I drained the pond, and found only four little mullets, very poor and very small, while there were about 250 fine fat carp of three different sizes. Under these circumstances I have come to the conclusion that the carp, being a very greedy fish, kept the mullets away from food and worried them to death; and I believe, in general, that if carp mullets, or any of the sucker tribe, are put in a pond with carp, the latter will eventually starve out and destroy the former species.

Some years ago I had millions of these mullets in my pond. They grow to weigh $1\frac{1}{2}$ to 2 pounds, and are an excellent table fish if taken in the fall or spring, but become insipid and soft in warm weather. They are the only fish I ever succeeded in raising in my ponds except

---

* This fish, scientifically known as *Moxostoma carpio* (Val.) Jordan, is mentioned in Jordan & Gilbert's Synopsis of North American Fishes, page 139; while the quarto History of Aquatic Animals, page 614, speaks of several species of red horse (*Moxostoma*) or suckers, of which this seems to be one, as somewhat common in the West and South; and the carp mullet is figured by name at Plate 222 *B* of this quarto.

the carp. My stock was procured from a mill-pond situated near Sandy Creek, in Davidson County, North Carolina.

DISEASE AFFECTING SPECKLED CATFISH.—Mr. B. B. White, writing from Thomaston, Ga., June 30, 1886, says that about a year ago he stocked a pond, previously occupied by carp, with speckled catfish; but that in the fall of 1885 they began dying. The old fish weighed from 2 pounds down, and they produced thousands of little ones about last September; but now all are gone except a few, and none of these are healthy. The pond is artificial, dug in a black muck swamp, and is fed by a constant spring of good drinking water.

SPECKLED CATFISH IN NORTH CAROLINA.—Mr. O. C. Anthony, writing from Centre, Guilford County, N. C., January 15, 1887, says that he has two ponds for fish-culture, one for carp, the other (which is about 100 by 40 feet and 4 feet deep) being devoted entirely to speckled catfish. In this last pond, in March, 1886, he put 10 speckled catfish obtained from Mr. J. F. Jones, of Hogansville, Ga.* They spawned in August, producing many hundred fry; and when he last saw them, before cold weather set in, these young fish were from 1½ to 2 inches long. Mr. Anthony expresses the opinion that the cultivation of specked catfish will be more profitable than carp culture.

SHAD ON STATEN ISLAND IN 1842.—"On the south side of the island, preparation is made in March for the shad fishery, which continues in April and May. This fish, when properly cooked, is one of the most exquisite and savory of the finny tribe. It is a migratory fish, and visits the northern streams annually, to deposit its eggs in the fresh water beyond the reach of the tides and voracious fish of the ocean. It formerly ascended the Hudson River above Stillwater, and spawned in Saratoga Lake, but the obstructions in its outlet at the mouth of Fish Creek have long since excluded them from that lake.

"After the shad has spawned, it becomes poor and thin, and so much altered as hardly to be known for the same fish. The old fishes which have not been taken in ascending our rivers, return with their young, and pursue their way coastwise until they reach the Gulf of Mexico. Every spring, shad frequent the Delaware, the Hudson, the Passaic, and Connecticut Rivers. They grow fatter as they gain more northern latitudes. At Charleston, S. C., in February, they are not esteemed. When they reach Philadelphia, in March, they are in good condition and fine eating. In April and May, they are still better in New York, and those taken in Connecticut River are esteemed the best.

"The shad is the *Clupea alosa* of scientific writers. (See Mitchell's New York Fishes.) On Staten Island the seine or draw-net is sometimes employed in taking shad, but the fike, or stationary hoop-net, is principally used to capture them. Along the southern and eastern shore of the island, every person who has a farm fronting on the water

* For an article on the speckled catfish, by Mr. Jones, see F. C. Bulletin for 1884, p. 321.

where the shad run, has his fike or fikes prepared in due season, and set at a proper distance from the shore. The fike is lifted at every low tide and the fish taken out. If the proprietor take more than is required for his own consumption, the surplus is sent to the New York market. Occasionally, in some situations, the fishery is more productive than the farm. But in the memory of the writer, the run of shad has very much diminished." [From Transactions of the New York State Agricultural Society, &c., for the year 1842, Vol. II, p. 194.]

MACKEREL OFF CAPE FEAR.—The United States Hydrographic Office, in a letter to Professor Baird, of February 12, 1887, said:

"The following report was received to-day from the Branch Hydrographic Office at Philadelphia. Schooner S. M. Bird, February 2, in latitude 33° 49′ north, longitude 75° 50′ west, saw many schools of mackerel, with large numbers of gannets and gulls over them. Three years ago the captain and mate of the schooner sighted mackerel in the same position."

SHAD IN THE SAINT JOHN'S RIVER, FLORIDA.—Dr. H. H. Cary, superintendent of the Georgia Fish Commission, writing to Professor Baird from La Grange, Ga., December 10, 1886, says:

The shad commence running in the Saint John's River the last of November, and fish from that point have been for sale in the Atlanta (Ga.) markets for the last ten days. The run of shad in the Saint John's last season was quite large, as was evinced by the rather poor appliances used in capturing them. It now seems that enough ripe fish can be taken to warrant the establishment of a shad hatchery on this river, which could be made the distributing point for the extreme Southern States.

SHAD HATCHING AND DISTRIBUTION IN CONNECTICUT IN 1886.—The report of the Connecticut fish commission for 1886 states that the shad-hatching operations at Birmingham, on the Housatonic River, conducted by Mr. Henry J. Fenton, were very successful. There were hatched and planted in the waters of the State 8,368,000 fry, at a cost of $1,000, the young shad being distributed as follows:

Connecticut River	3,000,000
Housatonic River	2,568,000
Thames River	1,300,000
Quinepiac River	1,000,000
Farmington River, tributary to the Connecticut	500,000
Total	8,368,000

SIZE OF FISH EGGS AND NUMBER CONTAINED IN A QUART.—The following data give the basis for computing the number of fish eggs of various species contained in a given measure. The table was prepared by Mr. Wm. F. Page, of Central Station, and it is thought will be found convenient for reference. The difference in count is considered to be due mainly to a difference in the size of the eggs.

Species.	Diameter of egg.	Number of eggs per standard quart of 57.75 cubic inches.	Authority.	How calculated.
	Inch.			
Spanish mackerel (*Scomberomorus maculatus*).	.040	*1,267,728	R. E. Earll	From diameter.
Codfish (*Gadus morrhua*)	.055	335,000	H. C. Chester	
Whitefish (*Coregonus clupeiformis*)	.125	†34,800	W. F. Page	By counting quart.
Shad (*Clupea sapidissima*)	.129	‡28,239	....do	Do.
Rockfish (*Roccus lineatus*)	.133	24,363		From diameter.
Rainbow trout (*Salmo irideus*)		§6,624	W. F. Page	By counting quart.
Brown trout, from Germany (*Salmo fario*).		8,301	E. M. Robinson	By counting 8 cubic inches.
Brook trout, domesticated (*Salvelinus fontinalis*).		‖11,092	William Buller	By counting quart.
Lake trout (*Salvelinus namaycush*)	.230	5,720	W. F. Page	Do.
California salmon (*Oncorhynchus chouicha*).	.250	3,696		From diamater.
Atlantic salmon (*Salmo salar*)	.266	4,272	W. F. Page	By counting quart.
Landlocked salmon (*Salmo salar* var. *sebago*).	.283	3,300	....do	Do.

* F. C. Report for 1880, p. 405.

† The number derived from F. N. Clark's count of fraction of quart is 36,800; see F. C. Report for 1880, p. 575. In February, 1887, W. F. Page found 33,450 in a quart of eggs, from Northville, by actual count.

‡ W. P. Sauerhoff obtained the following in May, 1886, from counts of 1 gill: Large eggs, 22,752; ordinary eggs, 28,800.

§ Other counts: F. N. Clark, from count of 1 fluid ounce (F. C. Report, 1882, p. 820), 12,800; G. A. Seagle, from count of 4 cubic inches, 9,485; E. M. Robinson, from 2 counts of 8 cubic inches, 7,625 and 6,875; W. F. Page, February, 1887, from count of 1 pint of eggs, from Shasta, Cal., 6,536.

‖ In February, 1887, W. F. Page counted 13 ounces of eggs, from Northville, yielding 13,998 to the quart.

PETITION TO RESTRICT FISHING IN MASSACHUSETTS.—The following petition was prepared late in the summer of 1886 for presentation to the next session of the Massachusetts legislature:

To the honorable the senate and house of representatives in general court assembled:

The undersigned respectfully represent that they are citizens of the Commonwealth of Massachusetts; that to us it appears that there is danger of the exhaustion of the food-fishes formerly so abundant in the waters upon our sea-coast; that we believe that one reason for the scarcity of such fishes is occasioned by the setting of stationery apparatus and the use of purse-nets and fykes, set and used in seasons which prevent their natural increase; that the scarcity now universally complained of is not occasioned by want of food, by the alleged impurity of the waters, nor by the depredations of one or more kinds of fishes upon others, but is due partly to overfishing and unseasonable fishing with the use of wholesale and improper apparatus.

That the time has come when, in order to preserve our fisheries, the general court should interfere by proper and timely legislation; that for a period of nearly forty years permission has been granted for setting and maintaining traps, pounds, and other apparatus, to the gradual but constant decrease of the fishes both in number and in size.

That the catching of fishes has been monopolized by a few, to the injury of the rights which belong to all, and to the probable exhaustion of the fisheries themselves; that it is but just that the experiment

should be fairly tried by the stopping, during certain seasons of the year, of the use of traps and all nets, to the end that it may be determined whether the fisheries may not be wholly or partially and gradually restored, and the public, on the whole, be better and more economically supplied; that in view of such costly scientific research as has been made, and such evidence as has been at the public expense collected, it is too late to say that the fishes have merely disappeared.

Wherefore, we pray that proper legislation may be had to prevent the setting of stationary apparatus for catching fish, and the use of nets and other movable devices, earlier than the first day of May in any year, with three open days after in each week, and for such other acts and laws as shall to justice and the well-being of the people in this regard appertain.

BILL AUTHORIZING INQUIRIES RESPECTING THE DESTRUCTION OF OYSTERS BY STAR-FISH, ETC.*—*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the Commissioner of Fish and Fisheries shall prosecute investigations and inquiries in respect to the destruction of oysters in the natural oyster-beds lying within the waters and jurisdiction of the United States, by star-fish, winkles, and other animals destructive to oyster life, and also whether any and what protective measures should be adopted in the premises, and shall report upon the same to the next Congress; and the sum of $10,000, or so much thereof as may be necessary for such purpose, is hereby appropriated from any money in the Treasury of the United States not otherwise appropriated, in order to enable said Commissioner to make the investigation herein provided for.

FISH AND LOBSTERS IN RARITAN BAY.—Mr. Uriah Seely wrote, about February 15, 1886, from Great Beds light-house, near South Amboy, N. J., substantially as follows: During the past summer there was better fishing than for years past in Raritan Bay and along the shore. Weakfish, bluefish, and striped bass were abundant; and there was an unusual quantity of horsefeet or king-crabs. The bay was full of menhaden most of the season, probably because the fish-oil companies have not fished for them here for two years by reason of the oyster-stakes tearing the nets.

Lobsters reappeared here again last season after an absence of about twelve years. I discovered them late in October, and caught about 100 before the cold weather set in, after which I could not catch any.

On January 20, 1886, a few days after the ice had left the bay, just before sundown, I saw a large black object, about 10 to 15 feet long, out near the channel. While looking at it, suddenly it surged up bodily and then settled out of sight and did not again appear; and I now suppose it was a small whale.

---

* This bill (H. R. 10436) was introduced in the House of Representatives by Mr. E. W. Seymour, of Connecticut, on January 10, 1887, and was read twice, referred to the Committee on Commerce, and ordered to be printed. On February 5, that committee reported the bill, with an amendment changing the appropriation to $5,000.

FISH TRANSPORTED FROM DUCK ISLAND TO DETROIT.—The following statement was furnished by Mr. C. W. Gauthier, a wholesale fish-dealer of Detroit, and was transmitted in a letter from H. C. Christianey, special deputy collector of customs, Detroit, Mich., dated October 23, 1886:

Fish transported by the steamer E. K. Roberts, from the Canadian fisheries at Duck Island in Lake Huron, to Detroit, Mich., from May, 1885, to and including August 30, 1886.

Kind.	1885.		1886.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
Whitefish	266, 169	$7, 985 07	176, 169	$5, 285 00
Trout	723, 707	21, 711 21	364, 143	10, 924 00
Pickerel	168, 805	5, 064 15	101, 569	3, 047 00
Sturgeon	183, 304	5, 499 12	30, 120	903 00
Frozen fish: Whitefish, trout, and sturgeon	186, 720	5, 601 60	....	....
Fish eggs	....	....	5, 300	265 00
Total	1, 528, 705	45, 861 15	677, 301	20, 424 00

GOLD MEDAL TO PROFESSOR BAIRD.—On April 30, 1886, the U. S. Department of State transmitted to Prof. Spencer F. Baird a letter of thanks and a gold medal which had been unanimously awarded to him by the departmental commission of fish-culture of the Lower Seine, France, on November 20, 1885, in acknowledgment of the supply of rainbow trout eggs (*Salmo irideus*) which resulted in the acclimatization of this species in the department of the Lower Seine. In his reply to the president of the commission, Professor Baird said that he would transfer the medal to the U. S. Fish Commission, as the service was rendered in behalf of that branch of the Government and not by him as an individual.

FISH-CULTURE IN SCOTLAND.—A circular from the Howietoun Fishery, Stirling, records the successful exportation of 200,000 salmon eggs to New Zealand and 100,000 Loch Leven trout eggs to Newfoundland last season. The landlocked salmon from Maine have thrived and will spawn next spring. The rainbow trout have not grown so rapidly as the Loch Leven. The prices of eggs per thousand are: Loch Leven, $5; brown trout, $5; American brook trout (*fontinalis*), $7.50. The prices for fry are just double these figures.

SARDINE FISHERIES IN FRANCE.—The boats used in fishing for sardines are about 20 feet in length. They are square at the stern and sharp and high forward, thus sailing more easily but being a little more liable to upset. The nets are not weighted with lead, and are about 65 to 100 feet long by about 20 to 25 feet wide, made of fine thread, and meshed so that the sardines run their heads through and are caught by the gills. The upper portion of the net is floated by corks, which keep it in a vertical position. The bait, which is exported from Norway, consists of codfish eggs which have been preserved in brine.

There are certain birds which, by flying above the shoals of fish, indicate to the fishermen where these shoals are to be found. When a shoal is discovered, the sails are lowered, the nets arranged and cast into the sea, the bait is scattered, and the sardines are speedily captured.

The fish are prepared for market as soon as possible. Women cut off the heads of the sardines, clean the fish, and place them one by one on slabs of stone or marble, on which salt has been scattered.

While this is being done, fires are lighted and large kettles are filled with olive oil of superior quality. When it begins to boil, the sardines are placed in layers in iron-wire baskets provided with handles. These baskets and their contents are then plunged into the boiling oil, after which they are put on shelves to drain, from which they are taken to the drying place, where they are sorted according to size.

Sardines packed in tin boxes are the object of special care. After the fish are put in, the boxes are filled with fresh oil and hermetically sealed, which sealing is tested by plunging them for some seconds into boiling water. Those not perfectly closed leak at this test, and the work must be done over again.

This maritime industry in France during a good season occupies from 25, 000 to 30,000 fishermen. During 1886, however, the season was very unfavorable, and the fishermen are in distress. [From the *Moniteur de la Pisciculture*, &c., 2d year, Series C, No. 24, Paris, France.]

TROUT AND CALIFORNIA SALMON IN AUSTRALIA.—The Melbourne Argus gives an interesting account of the successful conveyance and distribution of over 13,000 young fry of salmon-trout and brown trout reared from fish acclimatized at Sir Samuel Wilson's fish-hatching establishment at Ercildoune, Victoria. These fry were placed in 22 different streams and rivers with scarcely any loss, although carried great distances. From the same paper it appears that the California salmon introduced into Australian waters some years ago by Sir Samuel Wilson have been caught in various places up to 7 pounds weight.

SALMON FRY PLANTED IN NEW YORK WATERS.—Gen. R. U. Sherman, one of the fish commissioners of New York, writing from New Hartford, N. Y., on December 16, 1886, says:

" The fry of *Salmo salar* and *Salmo salar sebago* hatched last winter at the Cold Spring Harbor station and planted in the Saranac and St. Regis Rivers seem to have been a success, as numbers of the young fish 4 or 5 inches in length were seen in these waters last fall. These streams communicate with the St. Lawrence River, up which the *Salmo salar* have been accustomed to ascend and distribute themselves in the tributary streams from the first discovery of these waters.

SALMON FROM WASHINGTON TERRITORY AND SHAD FROM FLORIDA AND NORTH CAROLINA.—Mr. E. G. Blackford, writing from Fulton Market, New York City, on December 13, 1886, says:

" We are receiving in this market at present a number of salmon from Washington Territory, which are spawned male salmon and are of brilliant hues with horribly distorted heads.

"Shad made their appearance in market from Florida on the 3d of December. This morning one shad arrived from North Carolina, the first of the season."

SALMON FISHERIES OF SOUTHERN OREGON IN 1886.—Mr. Zachary T. Siglin, deputy collector of customs, writing from the custom-house at Coos Bay, Oregon, on December 9, 1886, gives the following interesting facts and figures in regard to this customs district:

"The following is the product of the salmon fisheries of the Southern Oregon district for the year ending December 31, 1886 (the fishing season having closed November 30, 1886). The products of the different fishing stations in the district are as follows:

	Barrels.
Salted on Coos Bay	2,340
Salted on Coquille River	1,230
Salted on Siuslaw River	1,432
Salted on Chetco River	550
Salted on Rogue River	92
Salted on Umpqua River	60
Total salt salmon	5,704

5,704 barrels of salted fish, at $10	$57,040
Number of cases canned in district, 44,482, at $4.50	200,169
Total value of fish	257,209

"Each barrel of fish contains 200 pounds, and each case contains 48 pounds, thus:

	Pounds.
5,704 barrels	1,140,800
44,482 cases	2,135,136
Total	3,275,936

"It is seen by the above report that the salmon fishing of this district is of considerable importance, being wholly confined to bays and rivers.

"The carrying of these fish to market is very irregular, as the vessels taking them are engaged in a regular and steady freighting business, carrying coal, lumber, agricultural products, merchandise, &c., the fish constituting but a minor portion of the cargoes. Whenever there is a quantity of barrels or cases ready for shipment, they are taken to market along with other freight. Thus it will be seen that the report of this class of fishing cannot well be made otherwise than as above."

RESOLUTION TO INVESTIGATE THE OREGON SALMON FISHERY.—Mr. Herman submitted to the House of Representatives the following resolution, which, on December 20, 1886, was referred to the Committee on Commerce and ordered to be printed:

"Whereas, a leading industry in the State of Oregon is the salmon fishery, the value of the export shipments for 1884 being $3,000,000, embracing 672,350 cases of canned salmon, while the same year the total wheat and flour export was valued at $5,600,000; and so rapidly has

this industry grown in value to the State and nation that in capital employed in fisheries Oregon stands eighth in order among the States; in persons employed, fifth; and in value of fish products, the third in order; and

"Whereas, it is reported that the propagation, increase, and growth of said fish are greatly retarded by injuries received from imperfect and ill-devised fish-ladders, fishways, nets, seines, fish-traps, fish-wheels, and other devices, and often from poisonous matter deposited in the navigable streams of said State, and that great quantities of said fish not matured are caught, killed, molested, and injured by said wasteful methods of capture and unhealthy deposits, thereby depleting the great supply and seriously interfering with the proper maturing of the young fish: therefore,

"*Resolved*, That the United States Commissioner of Fish and Fisheries be, and he is hereby, directed to investigate the methods of fishing pursued in said State, and to ascertain those which are most injurious to the preservation of this industry, as well as to the regulations and stringent measures deemed necessary to prevent future waste and wanton destruction; also to inquire as to the authority and constitutional power of the Government to regulate and protect the fish and fishery interests on navigable waters of the nation, or on any waters forming the boundary between States or States and Territories, and to report to this House."

RESULTS OF PLANTING WHITEFISH FRY IN LAKE SUPERIOR.—Mr. W. David Tomlin, writing from Duluth, Minn., on December 31, 1886, says:

"The fishermen belonging to the Duluth Fishery Association have noticed large numbers of young whitefish in the Lake Superior entrance of Allouez Bay. Competent judges among the fishermen, who have seen the fry for many years, say there is no question about their being whitefish. Some of them think they can recognize a difference in the fish, and say that they resemble the Lake Erie whitefish. This is a positive indication that planting fry is resulting successfully, and will in a short time restore the fishing grounds of this famous lake."

CODFISH PLANTED IN CAPE COD BAY.—Capt. J. W. Collins, commanding the Fish Commission schooner Grampus, in a letter from Gloucester, Mass., January 28, 1887, states that the Grampus left Wood's Holl at 11.10 a. m., January 27, with 2,000,000 young codfish on board. The fry kept in excellent condition, with a temperature of 34° Fahr., and there seems to have been no mortality whatever. At 7.30 a. m. of the 28th they were planted in Cape Cod Bay, in 29 fathoms, Race Point bearing E., 3½ miles distant, temperature of air and water being 33½°. The plant was made successfully, it being young flood when the fish were put overboard, and the tide probably carried them from 3 to 5 miles farther up the bay.

A MAN KILLED BY A SWORDFISH.—Mr. W. A. Wilcox, writing from Gloucester, Mass., on August 12, 1886, tells of an unusual occurrence,

from which letter and a newspaper clipping of a few days later the following is taken:

Capt. Franklin D. Langsford, of Lanesville, Mass., while out in a dory in Ipswich Bay, struck a swordfish with a harpoon. The fish at once turned upon them, thrusting his sword through the dory and into Mr. Langsford several inches, striking him near the base of the spine. On August 12 the captain died from peritonitis. The fish that drove his sword through the boat weighed over 300 pounds, and the sword measured about 4 feet in length, half of it being broken off in the boat. This is the first accident of the kind which has resulted in the loss of life that is known to have been recorded here.*

MACKEREL, BLUEFISH, CODFISH, ETC., OFF NORTHEASTERN MASSACHUSETTS.—Mr. James W. Elliott, keeper of the Plum Island Life-Saving station, near Newburyport, Mass., in a letter dated April 19, 1886, gives the following note on the fisheries near that station:

"The first mackerel caught near Newburyport was taken June 10, 1885, and small catches were made for a few days; then no more were seen until June 25, when small schools were seen in the bay well off shore, a few being caught nearly every day up to August 23, when large schools made their appearance and many were caught by seines. They remained for a few days and then left for other grounds. At intervals of from a week to ten days they returned, and during all the time there were some caught within a radius of 15 miles of this place. The last school of any amount was here about September 30, when for a few days many were caught in sight of this station.

"The first bluefish was seen on August 9, 1885; but only two were caught in this vicinity. A number were caught about 7 miles south of this station until August 11, when they disappeared entirely. It was quite a large school, but they would not take the hook.

"Codfish have been caught between the Isle of Shoals and the station all the year, but none were taken within three miles of Plum Island until about March 10, 1886, when small quantities were caught at times. We set traps several times within 2 miles of the shore, and caught nothing, neither could we catch more than a very few on the ledges near the station. One whale was seen on April 17, 1886, blowing about a mile off shore, the only one seen from here since last October. Some few codfish and haddock were caught near the shore about April 15."

SOME LOCALITIES WHERE CHICKEN HALIBUT ARE FOUND.—Capt. J. W. Collins, writing from Gloucester, Mass., January 7, 1887, refers to a letter from Professor Baird to Mr. W. A. Wilcox, in which it was stated that during October, 1886, there were shipped to New York 1,000 pounds of halibut that averaged 3 pounds each, which had been taken largely by vessels fishing on Cashe's, Jeffrey's, and New Ledge, on clean sand or rocky bottom. Captain Collins then continues:

* For a remarkably persistent attack of a swordfish upon a vessel, see Fish Commission Bulletin for 1886, page 143.

"The fishermen often find young halibut in considerable abundance on Cashe's, New Ledge, and Tippinies, the last fishing ground being most noted for their occurrence. When haddock fishing, about 15 years ago, we often caught chicken halibut in about 40 to 45 fathoms of water, ESE. from Chatham. On one occasion we took about 60 small halibut on a single set of our haddock trawls. Strangely however, a full-grown halibut is seldom caught in any of these localities; and it would be useless to look there for breeding fish. I have seen halibut, varying from 15 to 40 pounds in weight, very numerous on Grand Manan Bank, in shallow water where the tide runs hard."

DEAD FISH ALONG THE COAST OF SOUTH CAROLINA*.—Mr. W. St. J. Mazyck, writing from Waverly Mills, S. C., January 15, 1887, incloses a newspaper clipping, from which, together with his letter, the following is extracted:

For 30 miles along the upper coast of South Carolina, from Pawley's Island to Little River, the beach is so thickly covered with dead fish that the sand can scarcely be seen. These dead fish are of the kind known as menhaden, porgies, or fatbacks, most of them being about 5 inches long, and are valuable for fertilizing purposes. They were first observed, it is said, on December 29, 1886. The people along the coast, and for miles into the interior, are hauling the dead fish away and using them for manure. This same phenomenon is also reported at other neighboring points along the coast, and opinions differ as to what is its cause. Menhaden were noticed in Long Bay, off Pawley's Island, in June last, but were not observed again during the season.

In a letter of February 8, 1887, inclosing a communication on this subject from Mr. Taylor, Mr. Mazyck adds: "As far as I can learn, about 1,500 bushels of these fish have been hauled away for manure."

DEAD FISH ALONG THE COAST OF SOUTH CAROLINA.—Mr. J. Manigault Taylor, in a communication to Mr. W. St. J. Mazyck, from Waverly Mills, S. C., February 5, 1887, giving an account of his observations regarding dead fish thrown upon the shores of some islands on the coast of South Carolina, says:

"On December 24, 1886, I noticed a number of small menhaden floating dead in the creek that separates Pawley's Island from the mainland. This was rather surprising, as they are fish that disappear at the coming of cool weather. On the next day the number was largely increased, and the whole marsh for miles was gray with them, as the receding tide had left them in the forks of marsh stalks. That night the odor from dead fish on the beach became very unpleasant, and on the 26th, when I walked over to the beach, the sight was astonishing. The tide, which was nearly low water, left the beach 75 yards wide from high-water mark. This was completely covered, from 18 inches deep at the top down to an average of 6 inches deep; and the water was so thick with dead fish for at least 75 yards out that the surf could not

* For other notices in this Bulletin, of similar occurrences, see pages 140 and 194.

break at all. These were all menhaden from about 2 to 4 inches long, with now and then a big shrimp among them. I found that the whole beach of this island* was as described, as were the shores of Magnolia Island on the north and of Debardue Island on the south. Here, then, are 20 miles with this deposit 150 yards wide from 6 to 18 inches deep, and I am informed that it extends as far north as Little River, 36 miles from here. The most tenable theory to account for this, that I know, is that some eruption has taken place at the bottom of the ocean somewhere south of us, throwing into the water sulphurous or other noxious gases, and the southerly winds that prevailed for three weeks previous brought the dead fish to this coast."

ESTABLISHMENTS FOR UTILIZING FISH PRODUCTS.—One of the most remarkable of recent developments in the way of making the most and best of the fishing industry is the establishment of the Normal Company, which is now setting up factories at various parts of the coast of Great Britain. In an article describing the enterprise, the Edinburgh Scotsman says: The production of cheap and nutritious food is the principal object of the company, whose factory at Aberdeen, Scotland, in interest and extent, surpasses the famous fish-refuse and oil-making factories of the United States. The work includes the manufacture of fish extracts, for which there is a large demand both at home and especially on the continent, of glue, gelatine, and manure, from fish refuse, and the preserving of fish in a body by new and improved methods. Fish of all kinds are used, and transformed into extracts, soups, sausages of various kinds, glue, cement, gelatine, albumen, oils for medicinal and other purposes, leather, guano, and bone-meal. The processes of manufacture are a triumph of scientific skill. The methods of preparation, which are secured by patent, were invented by Mr. C. A. Sahlström, as were also many of the machines employed in the manufacture. One extract of meat produced by the company is made exclusively from the flesh of whales and allied marine animals. It takes time to overcome prejudice, but in reality the flesh of the whale resembles that of reindeer, and it is entirely free from smell or any oily flavor. The meat of a large blue whale of 200 tons yields, in round numbers, 5,000 pounds of extract, and every pound of extract gives about 100 pints of soup. Other soups are made in variety to suit the palate of the most fastidious. As an example of what is achieved in turning the so-called "offal" to account, it need only be mentioned that the flesh of the cod, ling, and other kinds of fish can be used dried or for extract, glue, and guano; the bladder for isinglass; the backbone for glue and bone-meal; the head for extract, glue, and guano; the roe for albumen; the liver for oil, extract, and fibrine; and the entrails for glue and guano. The external coverings of the larger kinds can be profitably removed and tanned. They give a strong and good skin,

* Pawley's Island: Mr. Taylor was the only person living on the island during the winter.

very suitable for portfolios and book-binding. Raw materials now considered as almost worthless are thus utilized to great advantage by the company. The Aberdeen factory covers an area of 39,200 square feet, and includes a dining-room and restaurant (opened a few days ago), as well as a drying chamber and drying machine, where the largest fish may be dried in from 12 to 20 hours, giving a far better result than if dried in the open air. Large factories are also in course of erection at Barra (an island of the Hebrides) and Thorshavn (capital of the Färöe Islands), each of which will employ 150 men all the year round. It is proposed to establish restaurants in various populous places, where dinners of two dishes, mostly produced from fish, can be had for twopence. [From the Fish Trades Gazette, London, England, February 5, 1887.]

FISH CONVEYED INLAND BY RAILWAYS IN GREAT BRITAIN.—The total quantity of fish conveyed inland by railways in the three countries of Great Britain during the past six years are summarized in tons as follows:

Country.	1880.	1881.	1882.	1883.	1884.	1885.
England	194, 561	203, 778	205, 939	215, 489	254, 988	242, 257
Scotland	50, 944	49, 259	56, 874	66, 117	68, 738	73, 858
Ireland	7, 447	7, 279	6, 372	8, 565	7, 688	8, 309
Total	252, 952	260, 316	269, 185	290, 171	331, 414	324, 424

On the north and east coasts of England in 1885 more than 1,000 tons of fish were sent from 12 places, Grimsby taking the lead with 66, 790 tons. Nine ports on the south coast of England send over 1,000 tons by rail; while on the west coast five ports send a similar amount. Thirteen railway companies carry this total amount of fish inland, six of which are carrying less fish in 1885 then they did in 1880, which may be the effect of the railway rates. The Scotch ports sending inland 1,000 tons or more of fish in 1885 are 22 in number, Aberdeen leading the list with 6,708; while in Ireland there is only one port that exceeds 1,000 tons, Kinsale in 1885 sending 1,603 tons. [From the Journal of the National Fish Culture Association, London, England, January 15, 1887.]

SHAD IN CALIFORNIA.—Mr. R. H. Buckingham, president of the California fish commission, writing from Sacramento in January, 1887, states that shad are taken in that State during every month of the year, while but a few years ago none were to be found; and it is thought that the first was taken in April, 1879, in a gill-net, the weight of the fish being five pounds. Now the whole California coast is well stocked with shad. There is no State hatchery for this species here, but at the spawning season great numbers of the breeding fish get into the swampy lakes near Sacramento, where thousands of the young hatch and remain there landlocked until the rise of water in autumn, when they find their way to the river and thus go to the sea.

Monthly summary of the fresh fish, oysters, &c., inspected by the Health Officer of the District of Columbia during the year 1886.

Kinds.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Black bass, big-mouth *a* * ..... pounds..	600	1,800								2,800	2,800		8,000
Carp ..... number..		17		2	22					3	15		59
Catfish* ..... pounds..	8,565	8,295	34,350	47,145	22,380	29,710	26,010	21,575	15,955	26,130	18,725	6,070	264,940
Clams ..... number..				73,800	411,000	595,000	527,000	466,000	302,000	14,000			2,388,800
Crabs ..... do....				14,000	125,500	152,100	184,400	149,300	65,800	900			692,000
Croakers* ..... pounds..								2,925	1,175				4,100
Drumfish ..... number..					3			2	33	13			51
Eels* ..... pounds..	85	395	1,415	9,375	5,610	2,160	2,060	1,795	1,785	3,125	4,125	370	32,300
Flounders* ..... do....									270	2,685	845		3,800
Herring ..... number..			331,814	4,390,005	2,247,250	38,624							7,007,723
Hogfish *b* * ..... pounds..								190					190
Mud shad *c* * ..... do....	8,185	8,390	4,005							740	4,475	1,260	27,055
Mullets, fresh-water* ..... do....	3,615	2,590	5,500	3,965	120		335	315	115	3,185	4,910	385	25,035
Oysters ..... bushels..	29,150	23,500	34,610	20,250	3,135	1,055	630	870	13,600	41,400	63,300	49,600	281,100
Pike* ..... pounds..	2,910	3,190	19,695	2,945	90	595	2,405	1,650	380	2,895	7,035	3,020	46,840
Scup *d* ..... number..						492	91						583
Shad ..... do....			6,544	133,733	38,526	2,274							181,077
Sharks ..... do....							1						1
Sheepshead ..... do....					110	437	141	58	161	63			970
Spanish mackerel ..... do....						1,149	2,961	2,141	424	247			6,922
Spots *e* * ..... pounds..						1,050	4,415	21,785	6,840	4,715			38,805
Striped bass *f* * ..... do....	6,135	2,065	43,580	23,550	6,935	15,425	26,150	35,690	31,455	85,335	126,775	35,515	441,610
Sturgeon ..... number..				11	432	698	147	166	163	4			1,621
Tailor shad *g* ..... do....				5,707	122								5,829
Tailors, salt-water *h* * ..... pounds..					4,200	32,000	25,875	56,680	41,975	11,705			172,435
Turtles, green *i* ..... number..					4	15	2	1	1				23
Weakfish *j* * ..... pounds..				675	31,700	20,100	10,555	21,735	17,785	48,455	465		151,470
White perch* ..... do....	490	4,070	24,050	23,500	8,500	11,815	14,790	10,065	9,165	14,685	37,155	9,315	167,600
Yellow perch* ..... do....	5,990	5,280	23,570	8,380	990	2,615	1,445	775	810	4,980	6,475	2,810	64,150

* Reported in bunches, but here reduced to pounds on the basis of 5 pounds to the bunch.
a Or North Carolina chubs.
b Or grunts or pigfish.
c Or winter shad.
d Or porgies.
e Or goodies.
f Or rockfish.
g Or hickory shad or fresh-water tailors.
h Or bluefish.
i Or sea turtles.
j Or gray trout or squeteague.

Vol. VI, No. 27. Washington, D. C. Mar. 24, 1887.

119.—A MAN KILLED BY A SWORDFISH.*

By W. A. WILCOX.

[From a letter to Prof. S. F. Baird.]

The schooner Venus is a small vessel of about 12 tons, owned and commanded by Franklin D. Langsford, of Lanesville, Mass., with a crew of three men, engaged in the general fisheries off the coast of Massachusetts. On Monday morning, August 9, Captain Langsford sailed from home in pursuit of swordfish. About 11 a. m., when 8 miles northeast from Halibut Point, in Ipswich Bay, a fish was seen. The captain, with one man, taking a dory, gave chase, and soon harpooned the fish, throwing over a buoy with a line attached to the harpoon, after which the fish was left and they returned to the vessel for dinner. About an hour later the captain, with one man, again took his dory and went out to secure the fish. Picking up the buoy, Captain Langsford took hold of the line, pulling his boat toward the swordfish, which was quite large and not badly wounded. The line was taut as the boat slowly neared the fish, which the captain intended to lance and thus kill it. When near the fish, but too far away to reach it with the lance, it quickly turned and rushed at and under the boat, thrusting its sword up through the bottom of the boat 23 inches. As the fish turned and rushed toward the boat the line was suddenly slacked, causing the captain to fall over on his back; and while he was in the act of rising the sword came piercing through the boat and into his body. At this time another swordfish was in sight near by, and the captain, excited and anxious to secure both, raised himself up, not knowing that he was wounded. Seeing the sword, he seized it, exclaiming, "We've got *him*, any way!" He lay in the bottom of the dory, holding fast to the sword, until his vessel came alongside, while the fish, being under the boat, could not be reached. Soon the captain said, "I think I am hurt, and quite badly." When the vessel arrived he went on board, took a few steps, and fell, never rising again. The boat and fish were soon hoisted on board, when the sword was chopped off to free the boat, and the fish was killed on the deck of the vessel. The fish weighed 245 pounds after its head and tail were cut off and the viscera removed; when alive it weighed something over 300 pounds. Captain Langsford survived the injury about three days, dying on Thursday, August 12, of peritonitis. The certificate of Dr. Garland written on the 16th of August is appended, giving some further particulars, and the sword has been deposited in the U. S. National Museum.

*A preliminary notice of this appeared among the notes of this Bulletin at page 411.

CERTIFICATE OF DR. JOSEPH GARLAND.

This may certify that I was called to visit Franklin D. Langsford, of Lanesville, in Gloucester, on August 12, in consultation with Dr. Levi Saunders, who was in attendance upon the said Langsford, on account of a wound inflicted upon his body by a swordfish on the 9th instant, said swordfish having driven its sword through the bottom of the fishing-dory he was in to the length of 23 inches, penetrating the body of Langsford at the right of the os coccyx and entering about 7 inches, by the side of the rectum, into the pelvic cavity; that said Langsford was dying, and did die, in my presence, of peritonitis, having survived the injury about three days; that the sword accompanying this certificate is the veritable sword that occasioned the accident, and is to be sent to the National Museum, at Washington.

GLOUCESTER, MASS., *October* 14, 1886.

120.—NOTES ON THE NEW ENGLAND FISHERIES IN NOVEMBER, 1886.

By W. A. WILCOX.

During the month the fishermen have used their best exertions to make up in a measure for an unprofitable season. The result has not been satisfactory, as the mackerel, pollock, and shore-herring catch all proved more or less a failure, while the codfish catch showed a slight gain over that of the corresponding month of last year.

The amount of mackerel landed by the New England fleet at the leading ports was the smallest of any November for years, namely:

Locality.	Fares.	Barrels.
From off provincial shores	17	2,547
From off the New England coast	51	2,809
Total, in sea-packed barrels	68	5,356

The total amount of the catch up to November 30 was about 80,000 sea-packed barrels. The arrivals from the Gulf of Saint Lawrence, with few exceptions, had a small amount of fish, some not a barrel, after having spent from two to three months on the fishing-grounds. Among the last arrivals from off provincial shores were the schooners Fannie W. Freeman, from a two months' cruise, with 40 barrels of mackerel; Spencer F. Baird, absent three months, 11 barrels of mackerel; Herman Babson, 3 barrels of mackerel; J. H. French, the last arrival, 11 barrels of mackerel. These vessels caught no other kind of fish on their voyages. The late or fall catch of mackerel off the provincial shores was disappointing and a failure to all engaged, native, shore, and

vessel fishermen, as well as to the American fleet that fished farther out. The mackerel, which is always a strange fish to understand in its habits and migrations, has proved more so than ever during the past season, and for once has largely escaped capture. During all the month mackerel have been reported more or less abundant in Massachusetts and Barnstable Bays, yet seldom showing up in any considerable quantity, and consequently the catches were mostly small, while the size has generally been large and the quality good. During the month most of the fishing-vessels of New England arrived at home ports and hauled up for the winter. As usual, Gloucester will have quite a fleet of registered vessels engaged in the frozen-herring business, and a much reduced fleet fishing on George's Bank and the fishing-grounds near home. Boston and Provincetown will also have a reduced fleet engaged during the winter in supplying the demand for fresh fish. The pollock catch about Cape Ann in November is largely taken by the Gloucester fishermen in gill-nets, fished near their homes. This season the fish have been scarce and more widely scattered than in former years. They are found more abundant than usual on Jeffrey's Bank, yet only a light catch was made. The following catch by the Gloucester gill-net fishermen shows a great decrease from that of one year ago:

Kind of fish.	November, 1885.	November, 1886.
	Pounds.	*Pounds.*
Codfish	336, 624	39, 850
Pollock	1, 923, 500	393, 400

The receipts of codfish at Gloucester vary but little from those of the corresponding month of 1885. Last year the catch during November was mostly taken on George's and Brown's Banks, while during the past month the receipts were largely from Western Bank, where fish of good size and quality were found in abundance.

The large fleet from Gloucester engaged in the halibut fishery supply nearly all the fresh and smoked halibut used in the United States. The demand annually increases, while the fish are becoming scarcer, except where they are found in any quantity in deep water of 200 to 400 fathoms, mostly on the Grand Bank and Banquereau. Receipts of halibut the past month show some gain over those of November, 1885.

Fishermen have had no cause to complain from want of bait. On Western Bank plenty of squid have been found all the month. Masters of vessels, knowing this, frequently sailed from home ports without bait, catching all they needed on the banks. Young herring, locally known as spirling, have been very abundant near Ipswich, Mass., and small or half-sized herring have been moderately plentiful about Cape Ann and Cape Cod, the catch being ample for all demands.

Only one vessel, the Arthur D. Story, of Gloucester, went to Bay of Islands, Newfoundland, for herring; she sailed under register, and has been reported as having secured a full cargo.

Quite a fleet under register will engage in the frozen-herring business, buying their cargoes in the Bay of Fundy and Fortune Bay. The first vessels to sail on a herring trip to the latter port in the past three years having started as follows: 1884, November 24; 1885, November 21; 1886, November 19. Seven sail started up to November 30, 1886.

Fish landed at Gloucester, Mass., by the fishing-fleet in November, 1886.

From—	Fares.	Mackerel.	Codfish.	Halibut.	Pollock.	Hake.	Haddock.	Cusk.	Menhaden.
Landed by Gloucester vessels:		*Bbls.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Bbls.*
New England shore	20	734							
Off provincial shores	15	1,907							
Western Bank	45		1,908,000	35,572					
George's Bank	43		771,000	14,100					
Banquereau	6			142,000					
Grand Bank	20		6,000	646,000					
Brown's Bank	2		70,000	550					
Nova Scotia Cape shore	1		25,000			4,000			
Jeffrey's Bank	10		3,300		115,000				
New England shore, trawls	25		32,000		71,500	23,000	3,000	17,000	
New England shore, gill-nets	127		39,850		393,400				
Small shore-boats			201,000		20,830				
Off Sandy Hook	1								280
Total	315	2,641	3,056,150	838,222	600,730	27,000	3,000	17,000	280
Landed by vessels from other ports: *									
Jeffrey's Bank	4		1,000		105,000				
Grand Bank	1			30,000					
New England shore, trawls	4		6,000			41,000	2,000	3,000	
Total	9		7,000	30,000	105,000	41,000	2,000	3,000	
Total, November, 1886	324	2,641	3,063,150	868,222	705,730	68,000	5,000	20,000	280
Total, November, 1885	609	6,564	2,978,424	658,100	1,941,500	163,000	43,000	26,500	

*During the month fish were landed by the following schooners: Good Templar, William H. Craig, and William Keene, of Portland, Me.; Flying Dart and Mary S. Hontvet, of Portsmouth, N. H.; Della F. Tarr, of Rockport, Mass.; and Loring B. Haskell, of Boston, Mass.

Miscellaneous receipts of dried, smoked, and pickled fish, oil, and bait at Gloucester Mass., in November, 1886.

From—	Mackerel.	Hake.	Haddock.	Herring.	Smoked herring.	Fish-oil.	Fish-bait.
	Barrels.	*Quintals.*	*Quintals.*	*Barrels.*	*Boxes.*	*Barrels.*	*Barrels.*
Maine		700	23				
Ipswich, Mass							1,934
Lanesville, Mass				188			
Tiverton, R. I.						1,623	
Grand Manan, New Brunswick	19				10,030		
Prince Edward Island	32						
Total	51	700	23	188	10,030	1,623	1,934

GLOUCESTER, MASS., *November* 30, 1886.

121.—DISADVANTAGE OF PLANTING SMALL FISH.

By FRANK N. CLARK.

[From a letter to Prof. S. F. Baird.]

I am not surprised at the negative results attending the planting of fry of various species of fish in Goguac Lake and in several other lakes in Michigan.* Not that these waters cannot be stocked with the varieties with which the attempt has been made, but I believe it can be done only by introducing yearling or adult fish instead of fry. For a long time I have been satisfied that the practice of planting larval fish in strange waters is a mistake, and that the chances of success would be much greater by using fish that had passed this stage. While I must admit that the planting of fry has, in exceptional instances, established a species, I think it has been only where the new waters were identical in every essential particular with the old.

It is all very well to return young fish at a very tender age to the waters whence the embryos were obtained, as the conditions in this case are all in accordance with the requirements of their nature, and they stand an equal chance with the fry from the spawning-beds. But their hold on life is too feeble to survive the changed conditions of food, temperature, &c., incident to strange waters. At partial maturity, however, their vitality is far greater than in infancy, and they are not only able to survive new conditions, but also to seek and appropriate those most congenial and best adapted to their requirements, and full acclimatization for themselves and posterity follows. In short, the adults are capable of adapting themselves to a far wider range of conditions than are the fry, and hence are more likely to survive the exigencies of pioneer life.

I think that the success which has attended the distribution and planting of carp is due very largely to the fact that they have not been

---

**Battle Creek, Mich., October* 9, 1885.—W. D. Marks, superintendent of the Michigan fish-hatcheries at Paris, Mecosta County, has been making tests, in the interest of the State, in the lakes in this vicinity, to ascertain the result of fish-culture. One of the first lakes stocked with fish in Michigan was Goguac Lake, a summer resort one mile south of Battle Creek. This lake was planted ten years ago with the fry of the California salmon, landlocked salmon, carp, whitefish, eels, speckled trout, and grayling, and since that time has been repeatedly planted with thousands and thousands of fry. Our citizens and our local sportsmen's club have taken great pains to protect the fish in this lake, even securing a special act of the legislature forever prohibiting the spearing of fish in the lake, and as the law prohibits the catching of fish by nets in all inland lakes of Michigan, fishing by hook and line was the only mode allowed at Goguac. Superintendent Marks set 100 rods of gill-nets several nights, but did not catch a single variety of the fish planted ten years ago and since in the lake. He also tried the experiment in Metcalf's and Hamblin's Lake, and failed to find any signs of the fish. He also made the test in several of the lakes in the western part of the State, with the same result.—CHICAGO INTER-OCEAN.

transferred until they had passed the fry or larval stage. Of course it is not practical to treat whitefish, shad, &c., the same as carp, nor to rear the young in large numbers in ponds, but the adult fish could easily be transferred from native to new waters. In this way I believe that more than half the inland lakes and small waters of the Northern States could be stocked with whitefish, lake trout, or lake herring, or perhaps with all of these and other varieties. Elizabeth Lake, Oakland County, was formerly well stocked with whitefish, resulting from a plant of about 100 adult fish upwards of thirty years ago, which were hauled to the lake in casks from Lake Saint Clair by Mr. A. Whitehead, of Pontiac.*

NORTHVILLE, MICH., *October* 31, 1885.

122.—PLANTING WHITEFISH AND OTHER SALMONOIDS IN INLAND LAKES.

By MARTIN METCALF.

All the salmonoids, including the brook trout, grayling, &c., breed in sheltered, rapidly-running water of low and even temperature (or the equivalent of these conditions), the eggs being deposited and fertilized near the head springs or at such points as will secure the conditions named and not subject the eggs to freezing, as a slight frosting, or even a sudden change of a few degrees in temperature, is sufficient for their destruction. So, also, exposure to the direct rays of the sun, or in water at rest for but a short time, will destroy the eggs.

Most of this family of fishes spawn in late autumn and early winter, while only a few, such as the grayling, California mountain trout, &c., cast their ova in early spring. The spawn of the last-mentioned varieties will endure a somewhat higher temperature, but is still more susceptible to sudden change and less tenacious of life than the fall spawners.

It will thus be seen that the expectation of the successful natural reproduction of the salmonoids in lakes having no considerable visible inlet or outlet must meet with disappointment. Adult trout may survive for a time along with pickerel and bass, but their successful reproduction and the growth of the fry is impossible, as the perch, pickerel, bass, and other predaceous shallow-water fish would quickly devour the fry. There are whitefish in some of the deep inland lakes of Michigan, and the species has been there beyond memory, but this is because the whitefish is a deep-water fish and thus escapes from his predatory neighbors.

The promiscuous planting of any kinds of fishes in all sorts of waters, in Michigan as well as elsewhere, has been and must always be without

---

* The Michigan fish commission 7th biennial report, December 1, 1884, to December 1, 1886, p. 76, states that whitefish were about exterminated there in 1881.

satisfactory results. Especially is this true of depositing too many kinds together, without reference to the present inhabitants and special conditions of the waters and to the requirements of the new-comers. Many of the early plantings, however, in the waters of Michigan were largely matters of experiment, and need not be repeated.

BATTLE CREEK, MICH., *October* 26, 1886.

123.—NOTES ON THE NEW ENGLAND FISHERIES IN DECEMBER, 1886.

By W. A. WILCOX.

As usual at this season of the year, most of the fishermen and fishing-vessels are either idle or engaged in other callings. The severe losses in December of 1885 and previous years wisely lead to a partial temporary suspension of the fisheries. During the month there were many severe storms and much rough weather, yet accompanied by comparatively few disasters.

A much reduced fleet from Gloucester has continued in the cod fisheries of George's Bank and the fresh-halibut fishery of the more distant fishing-banks.

A number of sail from Gloucester and other ports have also engaged in supplying the large demand for fresh fish. Vessels have also sailed for the Bay of Fundy and Newfoundland for cargoes of frozen herring.

The receipts of salt cod at Gloucester have been mostly from Western Bank, and the amount varies but little from that of the corresponding month of 1885, which was principally from La Have Bank.

The catch of codfish off Cape Ann and particularly in Ipswich Bay has been light, the fish having been late in striking in or near shore; while the fewer vessels and boats engaged, and much rough weather, all combined, accounts for decreased receipts from the shore catch. The schooner Arthur D. Story, the only vessel sent to the Bay of Islands, Newfoundland, for herring, arrived at Gloucester on December 2 with 800 barrels of fish.

Mackerel of large size and fine quality remained in the vicinity of Cape Cod up to the middle of the month, the vessels engaged in this fishery having all hauled up; and the catch was confined to gill-nets, weirs, and traps, which realized over $50,000 from the late catch of mackerel.

The remaining weirs and traps along the Massachusetts coast were all taken up during the month. Owing to the abundance of bait on the fishing-grounds, the low prices obtained for it, and the scarcity of more valuable fish, their business has not shown much profit.

Squid continued very plentiful on Western Bank and George's Bank up to December 7. Many vessels left port without any bait, depend-

ing on taking it on the fishing-grounds, in which they were successful. During the last few days of the month (weirs and traps being up), for the first time during the season, fresh-fish bait was scarce, but clams were substituted and not much inconvenience was experienced.

Codfish have been unusually abundant on Western Bank during a large part of the season. Schooner Susie Hooper, of Gloucester, one of the last arrivals from there, reached her home port on December 14, having been absent only five weeks, bringing in 105,043 pounds of split cod. The fish were all taken with hand-lines from the vessel. This is reported as one of the largest fares of hand-line-caught salt cod ever landed at Gloucester.

Herring were scarce in the Bay of Fundy up to the very last of the month, when an improved catch was reported.

Halibut receipts at Goucester vary but little from those of December, 1885, the catch being mostly from the Grand Bank.

December brings to a close a year that opened with storms and disasters, followed by many other dangers and much excitement, low prices and light receipts, the smallest catch of mackerel for over forty years, and with few exceptions, an unprofitable year's work.

Fish landed at Gloucester, Mass., by the fishing-fleet in December, 1886.

From—	Fares.	Codfish.	Halibut.	Haddock.	Pollock.	Hake.	Mackerel.
Landed by Gloucester vessels:		*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Barrels.*
Western Bank	49	2,205,000	2,850				
George's Bank	13	281,000	1,100				
Jeffrey's Bank	3				28,000	6,000	
Banquereau	10		151,800				
Grand Bank	17	100,000	414,000				
New England shore	51	160,400		22,000	4,950		
Small shore-boats		92,000			2,350		
Gulf of Saint Lawrence	1						40
Total	144	2,838,400	569,750	22,000	35,300	6,000	40
Landed by vessels from other ports	8	42,300			300		
Total, December, 1886	152	2,880,700	569,750	22,000	35,600	6,000	40
Total, December, 1885	244	2,867,300	530,000	91,600	24,150	20,500	

Miscellaneous receipts of dried, smoked, and pickled fish at Gloucester, Mass., in December, 1886.

From—	Mackerel.	Hake.	Herring.	Smoked herring.
	Barrels.	*Quintals.*	*Barrels.*	*Boxes.*
Grand Manan, New Brunswick	29	540		3,691
Bay of Islands, Newfoundland			800	
Total	29	540	800	3,691

GLOUCESTER, MASS., *December* 31, 1886.

124.—QUESTIONS RELATIVE TO MACKEREL AND THE MACKEREL FISHERIES.

The following circular letter and questions have been distributed to captains of mackerel vessels going south at the opening of the fishing season of 1887:

The mackerel (*Scomber scombrus*) is one of the most important of the North Atlantic food-fishes. For many years fish of this species have been extensively sold fresh in Northern markets, while salted they form a staple of great commercial importance. Their capture and sale maintains a large industry.

It is considered very desirable to obtain from those engaged in the mackerel fishery a full and carefully prepared account of the habits and migrations of this fish for the present season, as it will be of great value in determining various questions relative to the subject. It is equally important to obtain all information relative to the fisheries of the Gulf of Saint Lawrence, as well as those prosecuted off our own shores.

I beg, therefore, to call attention to the inclosed list of questions as suggestive of the special data desired, and to request answers, at the close of the season, to as many as practicable, to be forwarded by mail addressed to the U. S. Commissioner of Fish and Fisheries, Washington, D. C.

Should you desire it, you will be furnished with a blank book in which to keep a daily record of your observations, so far as practicable, noting under each date items of interest, such as the appearance or non-appearance of mackerel (or other surface fishes, as menhaden, herring, and bluefish), the catch made by your vessel, the locality, condition of weather, &c. At the close of the season this book can be left with any collector of customs, who will forward it to Washington, or it can be sent direct to me by mail at the time of sending the answers to the questions in this circular.

Many very full and satisfactory communications have already been received in response to a former circular containing questions about the mackerel fisheries. Thanking those who have already responded for their efficient aid, I beg to call their attention to this revised series of questions, and to ask that they will read them attentively and add any new suggestions which may occur to them. Attention is especially requested to the questions relating to migrations and to the schooling and spawning habits of the fish.

A.—CHARACTERISTICS.

1. Are the mackerel now caught larger or smaller than those of five, ten, or fifteen years ago?

2. Is there any difference in the size of the mackerel caught at different seasons or on different grounds? Were the first fish the largest?

3. Has the use of the purse-seine in the past, in your opinion, had any influence on the size or fatness of mackerel caught off the New England coast?

B.—Migrations and Movements.

4. At what date and in what locality did you first see mackerel in the spring of 1887? Was this earlier or later than usual?

5. At what date and in what locality did you catch the first mackerel?

6. At what date and in what locality (approximately) were the first mackerel taken by the Southern fleet?

7. At what date did the mackerel disappear in the fall? Was this earlier or later than usual?

8. At what date and where did you last see mackerel during the season?

9. When the mackerel appeared in the spring, did they come (or show up) in a single large school or in many smaller ones? Were the schools first seen the largest?

10. By what route did they come in to the coast, and what direction did they take subsequently?

11. When going northward in spring what was their greatest and average daily speed, and in what kind of weather did they travel fastest?

12. During their northern migrations in the spring of 1887, at what date and at what distance from the shore did the main body of mackerel pass the principal headlands, as follows: Cape Hatteras, Cape Henry, Cape May, Sandy Hook, Montauk, Nantucket, Cape Sable, Cape Canso, Cape Breton, and Cape North, Cape Breton?

13. What were the favorite localities of the mackerel off the New England coast and in the Gulf of Saint Lawrence this season?

14. How far from the shore have they been seen?

15. How close to the shore and in how shallow water?

16. What percentage of the mackerel caught with purse-seines on the coast of the United States between the 1st of June and the close of the season were taken within 3 miles of land, and what percentage of the mackerel caught by Canadian vessels and boats fishing with purse-seines in the Gulf of Saint Lawrence were caught within 3 miles of land?

17. Are the movements of the fish affected by the presence of other fish preying on them?

18. Are the movements of the fish affected by the temperature, winds, or currents, or by the operations of fishermen using purse-seines?

19. How far south have you known our common mackerel to occur?

C.—Abundance, etc.

20. Have mackerel increased or decreased in abundance since 1886?

21. Does their capture with purse-seines affect their abundance?

22. Has the weather of any given summer any influence on the abundance or movements of the fish in the following year?

23. Have the weather and winds from March to June any influence on the movements of the fish and their abundance in the Gulf of Maine (Cape Cod to Nova Scotia) during the summer months?

24. When, where, and in what depth of water do mackerel spawn?

25. Are they as readily caught by hook and line or with purse-seines during the spawning season as at other times?

WASHINGTON, D. C., *March* 18, 1887.

125.—REPORT OF SHAD DISTRIBUTION FOR 1886.

By MARSHALL McDONALD.

The work of shad propagation and the production of the young for distribution was conducted on the Potomac River at Fort Washington and Central Stations, on the Susquehanna at Battery Station and by the steamer Lookout, and on the Delaware River by the steamer Fish Hawk. Shad for distribution were contributed as follows:

Battery Station, Susquehanna River	43,776,000
Central Station, Potomac River	28,151,000
Steamer Fish Hawk, Delaware River	21,018,000
Steamer Lookout	310,000
Total	93,255,000

The aggregate number of fry actually planted was 92,679,000. In this distribution liberal plants of shad fry have been made in the Potomac, the Susquehanna, the Delaware, and other tributaries of Chesapeake and Delaware Bays. The following is a summary by river basins of shad distributed during the season of 1886:

River basin.	Received from station.	Actually planted.	Lost in transit.
Tributaries of Narragansett Bay	2,534,000	2,534,000	....
Tributaries of Long Island Sound	832,000	749,000	83,000
Hudson River	2,312,000	2,312,000	....
Delaware River	21,618,000	21,618,000	....
Tributaries of Chesapeake Bay	52,923,000	52,835,000	88,000
Tributaries of Albemarle Sound	1,990,000	1,990,000	....
Streams draining into the Atlantic south of Albemarle Sound	4,288,000	4,183,000	105,000
Mississippi River and minor tributaries of the Gulf of Mexico	4,758,000	4,758,000	....
Colorado River, Gulf of California	1,000,000	850,000	150,000
Columbia River basin	1,000,000	850,000	150,000
Total	93,255,000	92,679,000	576,000

The localities at which the plants were made, the streams in which they were made, and the number of fish included in each deposit are given in the following table:

Record of distribution of shad from Central Station, Washington, D. C., and from Battery Station, Havre de Grace, Md., season of 1886.

CENTRAL STATION.

Date.		Stream stocked.	Tributary of—	Place of deposit.	Fish shipped.	Died in transit.	Planted.
1886.							
Apr.	24	Potomac River	Chesapeake Bay	Little Falls, Md	918,000		918,000
	25	do	do	do	364,000		364,000
	27	Rivanna River	James River	Charlottesville, Va	534,000		534,000
	28	Rappahannock River	Chesapeake Bay	Rappahannock Station, Va	340,000		340,000
	28	Rapidan River	Rappahannock River	Rapidan Station, Va	341,000		341,000
	29	Occoquan River	Potomac River	Woodbridge Station, Va	579,000		579,600
	30	Rappahannock River	Chesapeake Bay	Near Fredericksburgh, Va	730,000		730,000
May	1	Mattapony River	York River	Near Milford Station, Va	391,000		391,000
	1	North Anna River	Pamunkey River	C. & O. Junction, Va	391,000		391,000
	1	Fork of Shenandoah River	Potomac River	Near Waynesborough, Va	557,000		557,000
	2	Acquia Creek	do	Near Quantico, Va	389,000		389,000
	2	Accokeek Run	Acquia Creek	Brooke's Station, Va	200,000		290,000
	2	Rivanna River	James River	Near Charlottesville, Va	700,000		700,000
	3	Appomattox River	do	Near Mattoax, Va	379,000		379,000
	3	Monocacy River	Potomac River	Near Frederick Junction, Md	603,000		603,000
	3	Patuxent River	Chesapeake Bay	Laurel, Md	669,000		669,000
	3	Shenandoah River	Potomac River	Waynesborough, Va	200,000		200,000
	3	Rapidan River	Rappahannock River	Rapidan, Va	629,000		629,000
	4	James River	Chesapeake Bay	One mile above Bosher's Dam, Va	380,000		380,000
	5	Occoquan River	Potomac River	Bristoe, Va	531,000		531,000
	5	Chickahominy River	James River	Hunslett Station, Va	310,000		310,000
	7	Pamunkey River	York River	Near White House Station, Va	385,000		385,000
	7	Mattapony River	do	Near Milford, Va	367,000		367,000
	8	Dan River	Roanoke River	Two miles from Danville, Va	329,000		329,000
	9	Chickahominy River	James River	Fives miles from Ashland, Va	316,000		316,000
	10	Colorado River of the West	Gulf of California	The Needles, Colo	1,000,000	150,000	850,000
	10	Cheat River	Monongahela River	Three miles from Rowlesburgh, W. Va	356,000		356,000
	11	Chattahoochee River	Appalachicola River	West Point, Ga	370,000		370,000
	12	Stony Creek	Nottoway River	Near Stony Creek Station, Va	364,000		364,000
	13	Meherrin River	Chowan River	Near Belfield, Va	415,000		415,000
	14	do	do	1½ miles above Belfield, Va	314,000		314,000
	15	do	do	Near Margarettsville, N. C	300,000		300,000
	15	Fountaine's Creek	do	do	40,000		40,000
	16	Savannah River	Atlantic Ocean	Augusta, Ga	301,000	30,000	271,000
	16	Nottoway River	Chowan River	Near Stony Creek, Va	228,000		228,000
	17	Monongahela River	Ohio River	Two miles from Fairmont, W. Va	281,000		281,000
	21	do	do	Near Fairmont, W. Va	210,000		210,000
	21	Housatonic River	Long Island Sound	Birmingham, Conn	832,000	83,000	749,000
	22	Will's Creek	Potomac River	Cumberland, Md	532,000		532,000
	22	Rapidan River	Rappahannock River	Rapidan Station, Va	259,000		259,000
	23	Neuse River	Pamlico Sound	Goldsborough, N. C	200,000	20,000	180,000

	24	Tar River	Pamlico Sound	Two miles above Rocky Mount Station, N. C	448,000		448,000
	25	Youghiogheny River	Monongahela River	Connellsville, Pa	991,000		991,000
	26	Mattawoman Creek	Potomac River	Mattawoman Station, Md	463,000		463,000
	26	Quantico Creek	......do	1½ miles from Quantico, Va	548,000		548,000
	27	Patuxent River	Chesapeake Bay	2½ miles from Marlborough, Md	528,000		528,000
	28	Hudson River	Atlantic Ocean	Catskill, N. Y	921,000		921,000
	31	......do	......do	Albany, N. Y	1,036,000		1,036,000
	31	Taunton River	Narragansett Bay	Dighton, Mass	1,034,000		1,034,000
June	3	Catawba River	Santee River	Near Morganton, N. C	365,000		365,000
	4	Crab-Tree Creek	Neuse River	Near Raleigh, N. C	374,000		374,000
	5	Acquia Creek	Potomac River	2½ miles from Quantico, Va	370,000		370,000
	8	Hudson River	Atlantic Ocean	Catskill, N. Y	355,000		355,000
(*)				Cold Spring Harbor, N. Y. †	1,586,000		1,586,000
(*)		Potomac River	Chesapeake Bay	Fort Washington, Md	3,154,000		3,154,000
		Total			29,737,000	283,000	29,454,000

BATTERY STATION.

1886.						
Apr.	25	Susquehanna River	Chesapeake Bay	Near Station, Md	25,000		25,000
	26	......do	......do	......do	1,421,000		1,421,000
	27	......do	......do	......do	2,431,000		2,431,000
	27	......do	......do	......do	325,000		325,000
	28	......do	......do	......do	860,000		860,000
	28	Northeast River	......do	P., W. & B. R. R., Md	500,000		500,000
	29	Susquehanna River	......do	Near Port Deposit, Md	1,055,000		1,055,000
	29	Bush River	......do	Bush Station, Md	500,000		500,000
	29	Elk River	......do	Elkton, Md	500,000		500,000
	30	Susquehanna River	......do	Near Station, Md	50,000		50,000
	30	Gunpowder River	......do	P., W. & B. R. R., Md	500,000		500,000
	30	Northeast River	......do	......do	500,000		500,000
May	1	......do	......do	......do	500,000		500,000
	1	Patapsco River	......do	Near Relay Station, Md	500,000		500,000
	1	Bush River	......do	Bush River Station, Md	600,000		600,000
	1	Elk River	......do	Elkton, Md	600,000		600,000
	3	Susquehanna River	......do	Above Harrisburg, Pa	1,621,000	48,000	1,573,000
	3	......do	......do	Near Station, Md	1,952,000		1,952,000
	5	......do	......do	......do	804,000		804,000
	6	Palmer River	Narragansett Bay	Near Providence, R. I	1,500,000		1,500,000
	6	Susquehanna River	Chesapeake Bay	Near Station, Md	1,245,000		1,245,000
	8	Chester River	......do	Near Chestertown, Md	500,000		500,000
	9	Columbia River	Pacific Ocean	Wallula Junction, Wash	‡1,000,000		300,000
	9	Willamette River	Columbia River	Albany, Oreg		150,000	550,000
	9	Patuxent River	Chesapeake Bay	Odenton, Md	650,000		650,000
	11	......do	......do	Laurel, Md	500,000		500,000
	11	Gunpowder River	......do	P., W. & B. R. R., Md	600,000		600,000
	11	Bush River	......do	......do	300,000		300,000

* At sundry dates.

† Sent to Fred Mather to hatch and deposit.

‡ In addition to the fish, 585,000 eggs were shipped, hatched in transit, and are included in the 850,000 planted in Columbia and Willamette Rivers.

Record of distribution of shad from Central Station, Washington, D. C., and from Battery Station, Havre de Grace, Md., &c.—Continued.

Date.		Stream stocked.	Tributary of—	Place of deposit.	Fish shipped.	Died in transit.	Planted.
May	11	Northeast River	Chesapeake Bay	Bull's Monnt, Md	1,500,000		1,500,000
	12	Elk River	do	Elkton, Md	300,000		300,000
	12	Northeast River	do	P., W. & B. R. R., Md	300,000		300,000
	12	Susquehanna River	do	Near Station, Md	1,500,000		1,500,000
	12	Broad River	Congaree River	Columbia, S. C	750,000		750,000
	12	Saluda River	do	do	750,000		750,000
	13	Monongahela River	Ohio River	Grafton, W. Va	250,000		250,000
	13	Sassafras River	Chesapeake Bay	Ordinary Point, Md	1,000,000		1,000,000
	15	Chester River	do	Crumpton, Md	600,000	40,000	560,000
	15	James River	do	Clifton Forge, Va	250,000		250,000
	15	Susquehanna River	do	Near Port Deposit, Md	370,000		370,000
	16	Ocklockonnee River	Gulf of Mexico	S., F. & W. R. R., Ga	750,000		750,000
	16	Withlacoochee River	do	do	750,000		750,000
	16	Brandywine River	Delaware River	Wilmington, Del	450,000		450,000
	17	Cheat River	Monongahela River	Rowlesburgh, W. Va	300,000		300,000
	18	Nanticoke River	Chesapeake Bay	Seaford, Del	450,000		450,000
	19	Wicomico River	Tangier Sound	Salisbury, Md	450,000		450,000
	19	Chester River	Chesapeake Bay	Millington, Md	600,000		600,000
	20	Patuxent River	do	Patuxent, Md	540,000		540,000
	22	West Fork River	Monongahela River	Clarksburgh, W. Va	300,000		300,000
	24	Susquehanna River	Chesapeake Bay	Near Columbia, Pa	900,000		900,000
	25	do	do	Near Port Deposit, Md	750,000		750,000
	26	do	do	Peach Bottom, Pa	836,000		836,000
	26	do	do	Marietta, Pa	1,500,000		1,500,000
	27	Nanticoke River	do	Seaford, Del	977,000		977,000
	28	Susquehanna River	do	Conowingo, Md	500,000		500,000
	31	Deep River	Cape Fear River	Moncure, N. C	1,100,000	55,000	1,045,000
	31	Monongahela River	Ohio River	Fairmont, W. Va	200,000		200,000
June	1	Susquehanna River	Chesapeake Bay	Safe Harbor, Pa	550,000		550,000
	1	do	do	Tide's Eddy, Pa	500,000		500,000
	2	do	do	Above Havre de Grace, Md	100,000		100,000
	5	do	do	do	228,000		228,000
	7	do	do	Near Station, Md	429,000		429,000
	9	do	do	do	472,000		472,000
	10	do	do	do	298,000		298,000
	12	do	do	do	481,000		481,000
	13	do	do	do	256,000		256,000
		Total			43,776,000	293,000	43,483,000

EGGS FOR EUROPE.—In addition to the distribution covered by this table, 50,000 shad eggs were sent from Battery Station to Mr. H. C. Mercer, of Doylestown, Bucks County, Pennsylvania. Mr. Mercer had arranged to sail for Europe on the North German Lloyd steamer Eider April 28, and expected to reach Hüningen, Alsace. in ten days. He wished to take some shad eggs with him, and try to reach the Danube before they perished. He proposed to keep down the temperature of the eggs as much as possible while on board the steamer, by the use of ice. On April 27, 1886, Mr. Grabill forwarded the eggs to him. When he reached Southampton he found many of them dead, and the remainder died before he reached Bremen, to his great disappointment.

STOCKING THE COLORADO.—An attempt to acclimate shad in the Colorado River of the West, and to establish fisheries on the Colorado, Gila, and other tributaries of the Gulf of California, was commenced by the deposit of 983,000 fish in 1884 and 998,000 eggs in 1885, and was continued the present season by a deposit of 850,000 eggs, thus making a total of 2,831,000, all of which were deposited at The Needles. These plants are considered sufficient to determine whether the waters present such conditions as will assure the establishment of a run of shad in the streams tributary to this gulf. The evidence of success will be looked for in the capture of mature shad in the season of 1888, or possibly of male or buck shad in 1887. It is not proposed to prosecute this experiment further.

STOCKING THE COLUMBIA RIVER.—An unsuccessful attempt was made in 1886 to transfer shad from the Atlantic to the Pacific coast. Detentions on the way consumed so much time that the fry were all lost. In order to guard against loss occasioned by delay *en route*, the present year arrangements were made to send eggs as well as fry. Car No. 3, with J. F. Ellis in charge, was detailed for the purpose. The car was equipped with tanks for storing and a steam-pump for circulating the water. Two stands of McDonald jars, with specially designed glass aquaria for collecting and holding the fry, completed the equipment of the car as a moving hatchery. The car left Havre de Grace May 9 with 1,000,000 young shad, 200,000 eggs on trays, and 385,000 eggs in the McDonald hatching-jars. Mr. E. M. Robinson went on board to take charge of the hatching. The fry were transported with a loss of 50 per cent, while the eggs on trays were all lost. The 385,000 eggs in jars hatched and were planted in the Willamette River, with a loss of less than 10 per cent. The success of this experiment has so important a bearing upon the methods of our work, and points out such possibilities, that Mr. Ellis's report relative to the incubation and hatching of the eggs on the way is given.*

WASHINGTON, D, C., *March* 1, 1887.

* *May* 9, 1886. The 585,000 eggs arrived at the car at 2.20 p. m., 200,000 of which were put on trays in an ice-box. The other 385,000 came to the car in two Wroten buckets, and were put in four McDonald jars at 3.30 p. m. The pump was then started and a

slow motion given to the eggs. At 8.25 p. m. on May 6th 210,000 of these eggs had been taken, and 175,000 at 9.30 p. m. on May 7. The temperature of water at Battery Station when the eggs were taken was 56 degrees; the temperature of water in car was 60 degrees. Took on fresh water at York, Pa., at 10 o'clock p. m., from engine-tank, using our suction-hose and pumping about 30 minutes. Pumped the water through the ice-coil during the night, so the temperature was brought down to 58 degrees. Took on fresh water at Altoona, Pa., and after that pumped water from engine-tank three times each day.

May 10. The temperature was from 58 degrees to 60 degrees. The eggs worked nicely, with only a small loss. About a dozen or so of those taken on the 6th instant hatched this afternoon. The eggs look rather light in color, and the fish can be seen moving lively in the eggs. One jar of eggs went over in the aquaria last night; replaced them in jar at 6 o'clock a. m.

May 11. The temperature was from 56 degrees to 58 degrees. Only a few more fish hatched out, as the fall in the temperature of the water seemed to retard them. They all look well, and are developing slowly.

May 12. Got on a little alkali to-day; this did not seem to have any effect on the eggs. Those taken on the 6th instant are hatching to-day. Temperature of water 58 degrees. The fish look well, and have a large sac. Those taken on the 7th instant are almost ready to come out, and a few hatched before night. Worked all the dead eggs off and measured those left in jars; found the loss on the 210,000 eggs taken May 6 to be 10 per cent, and the loss on the 175,000 eggs taken May 7 to be 8 per cent. This would make an average loss of 9 per cent. We lost very few, ir any, after this. The eggs were hatching slowly this evening. The water in tanks got a little low, so the pump was used to get some air into the water. The air-bubbles attached themselves to the young fish and turned them head down; also collected around the jars and aquaria. This caused some trouble, which was overcome a little by keeping the lower tanks as full of water as possible.

May 13. The eggs of the 6th instant are hatching rapidly; temperature of water 58 degrees. The fish look healthy and strong, with large sacs. Those of the 7th are hatching slowly. Put up at 11 a. m. 25,000 fish in five cans, and 25,000 more at 5.30 p. m. The air-bubbles were still troubling the young fish a little, so took them from aquaria as fast as hatched.

May 14. Almost all the eggs of the 6th instant hatched to-day. The temperature of water went down to 56 degrees this morning. This retards the eggs of the 7th a little. The air-bubbles in the water seem to collect on some of the eggs, making them come to top of jar; so can give them but very little motion or they will go over in the aquaria. This air-bubble has been the only difficulty we have had to contend with, which seems strange, as the air-pump has not been in use on the trip. The air also collects on the shells and causes them to come to the top, when they can be easily skimmed off. Removed the young fry from the collecting aquaria to transportation cans as fast as they were hatched. Planted 25,000 of these fish in the Columbia River, at Wallula Junction, at 11.30 to-night. They were in fine condition.

May 15. The car arrived at Portland at 10.30 this morning. All the eggs of the 6th were hatched, and those of the 7th hatched rapidly all day, the temperature of water gradually going up to 62 degrees. The air-bubbles entirely disappeared this morning. The car was taken to the Willamette, at Albany, at 9.30 p. m., and the young fry planted at 11.30 p. m. The eggs did not quite all hatch to-day, so ran the pump up to 10 o'clock May 16, at which time all the eggs had hatched, with a total loss of 9 per cent. The experience of this trip makes it safe to recommend the shipping of eggs instead of the young fry on all long trips, as this is perhaps the most difficult trip in the country. The water is very cold, going as low as 44 degrees in a great many places. The alkali, too, is very strong. I think without doubt this car can take 2,000,000 eggs to any stream in the United States, and hatch them in as good condition as they come from the hatcheries, and with as small a loss.

Vol. VI, No. 28. Washington, D. C. Mar. 24, 1887.

126.—THE PEARL FISHERIES OF AUSTRALIA.

By Consul G. W. GRIFFIN.

The pearl-shell fisheries of Torres Strait belong to the colony of Queensland, and are situated 1,500 miles from Brisbane and more than 2,000 miles from Sydney. Torres Strait is about 80 miles in width, and separates Queensland from the island of New Guinea. The navigation of the strait, although said to be safe and practicable, is in fact very difficult, on account of the innumerable islands, reefs, and shoals scattered about. The chief places at which the fisheries are conducted are Wai Weer, Albany Island, Jervis Island, Endeavor Strait, Friday Island, Prince of Wales Islands, and Possession Island.

Wages of the men.—A good diver can earn from $60 to $150 per month. He usually signs shipping articles for a period not exceeding three years, at a fixed sum per month and an interest in the catch or lay. Mr. Bayne, of Sydney, the owner of an important station at Prince of Wales Islands, who for many years has been engaged in pearl-shell fishing, states that several divers in his employ have earned as much as $300 per month. The divers and crews are composed of South Sea Islanders, Malays, and a few Chinese and Lascars.

The diver is the captain of the boat, and the other men obey his orders. The duties of the tender consist in waiting on the diver, helping him to dress, and looking after him while in the water. The pay of the tender is from $10 to $12 per month, with a small interest in the catch, generally from one-sixtieth to one-eightieth part of the value of the shells. Each of the vessels generally has one diver and four tenders, who compose the crew. The tenders are engaged on regular shipping articles, and are paid off like any other merchant seamen.

Mr. Henry M. Chester, the resident magistrate at Thursday Island, says, in a recent report on the fisheries, that the natives are never overworked, and that they are always well fed and kindly treated. He further says that payment is usually made them in blankets, clothing, knives, hatchets, and beads, and that whenever they are dissatisfied with what they receive they seek other employment. Mr. Chester is of opinion that the competition for their services is of such a character as to secure for them fair treatment. All the available adult population of the island are employed as swimming divers, under "the masters and servants' act," and while their pay is small, it is made in the presence of the local authorities, and all the old men, women, and children receive food in seasons of scarcity. Mr. Chester admits, however, that the occupation of a diver is dangerous and not at all conducive to longevity, but adds that the loss of life among the natives from

such causes is more than counterbalanced by the abundant supply of wholesome food given them, and by the decrease in infanticide and other savage practices to which they were formerly addicted.

Methods of fishing.—The method pursued in pearl fishing is for a number of vessels to start out together and fish on the same ground. Each vessel carries supplies to last a fortnight. When in about 8 fathoms of water, if the tide is slack, the diver will jump overboard. His boots are heavily weighted with lead, so as to hasten his descent. Upon reaching the bottom he walks leisurely along until he comes to a patch of shells; then he signals to the boat to cast anchor. He carries with him a sack or bag to hold the shells, and as soon as it is filled it is lifted up, emptied out, and sent down to him again, he being able to remain under water several hours at a time. Some divers remain down from 9 o'clock in the morning until 5 o'clock in the afternoon.

The pearl-oysters lie on the ground, with the shells partly open, and great care is required in handling them, for if touched in the wrong way they will close upon the hand like a vise. Accidents of this kind not infrequently happen to inexperienced divers, who are obliged to signal those above to lift them up and remove the pearl-oyster from their hands.

The monsoons which blow in the strait from May until the end of September are often so severe that boats have to lay up for as much as ten days at a time. The average catch for each boat is from 1 to 1½ tons of shells per month. Unlike the fisheries in Ceylon and the Persian Gulf, there is little or no difficulty in collecting the shells, for they either lie loose on the ground or are only partially buried in the mud or sand.

The fisheries off the coast of West Australia, and especially at Shark Bay, produce the true pearl-oyster (*Avicula margaritifera*). For a long time this shell was supposed to be valueless on account of its thin and fragile structure, but now there is a great demand for it both in America and in Europe. It is especially prized by the French and German artists for fine inlaid cabinet work.

The young or chicken shell is the best, and commands the highest price. When the pearl-oyster is five or six years old the shells become blistered and wormy, and it is said that the oyster dies about the age of seven years. The divers in fishing make no effort to select any particular shell, but take every one that they can get, even the dead shells, which have the least value of any, on account of various blemishes, rottenness, lack of luster, &c. Pure-white silver-edged shells are the best.

The oysters in the West Australia fisheries are generally obtained by passing an iron dredge over the banks, but divers are also employed. Pearl-oysters are gregarious in their habits, and whenever one is met with it is almost certain that numbers of others will be found in the immediate neighborhood.

Divers are expert swimmers, and they go down to a depth of 4 or 5 fathoms, where it is said some of them can remain two minutes. The

occupation is an unwholesome one, and soon produces deafness and diseases of the chest and lungs. Blood not infrequently flows from the mouth, ears, and nostrils after the usual dip of forty or fifty seconds, which is repeated fifty or sixty times a day. The men also run the risk of being eaten by sharks, although death from this cause is not apt to occur except in untried fishing-grounds, as the noise of the divers is almost certain to drive the sharks away.

The pearl stations.—All the pearl-fishing stations in Torres Strait bear a very close resemblance to one another, and consist of a small but nice-looking residence for the manager and one of less pretension for the men, a warehouse for storing provisions, &c., and several sheds for drying the shells. Before the shells are brought to the station the boats usually run into land, and the men open the oysters, take out the pearls, if any, and throw the soft parts overboard. The shells are then roughly cleaned and stowed under the hatches. At the end of the voyage they are taken to the station, where they are counted and thoroughly cleaned. The shells are then assorted and dried, and after the outer edges are chipped off they are packed in cases, each case weighing from 270 to 300 pounds, and are ready for shipment.

No systematic effort has yet been made to collect pearls at Torres Strait, and such as are found become the property of the men, who secrete them in various ways, often by swallowing them. Some very fine specimens of pearls about the size of a hazel-nut, and of remarkable beauty and clearness, have recently found their way to the market from Torres Strait. Other specimens of a much larger size have been found there, but they were imperfect in shape and color.

Formation of pearls.—In oysters aged four years—which are judged by the shells, weight, and appearance—the best pearls are found. The shell, like the pearl, is formed by the secretion of the animal, and is composed of animal matter and lime. The iridescent hues on the inside of the shell are occasioned by the edges of the thin, wavy, concentric layers overlapping one another and reflecting the light. The minute furrows, containing translucent carbonate of lime, produce a series of more or less brilliant colors, according to the angle at which the light falls upon them. Occasionally some of the finest pearls are found loose in the shell. As many as one hundred pearls have been found in one oyster, but of little or no value. The pearls of the young oyster are yellow, and in the older oyster are of a pinkish hue.

The use of pearl-shells.—The pearl-shells shipped from Australia to the United States and Europe are used principally for the manufacture of knife-handles, shirt-buttons, &c. Considerable quantities are also used for papier-maché and other ornamental work. The pearl buttons, shirt-studs, &c., now made in the United States are said to be the best and cheapest in the world, a fact due in great measure to the care used in selecting the material and to the improved methods of cutting.

U. S. CONSULATE, *Sydney, New South Wales, April*, 1885.

127.—REPORT OF SHAD PROPAGATION ON THE POTOMAC RIVER DURING THE SEASON OF 1886.

By MARSHALL McDONALD.

The organization and conduct of the work was the same, in general, as during the season of 1885. The facilities for collecting eggs were greatly improved by substituting for the launch heretofore employed in the collection service the small steamer Lilla, chartered for the season, but at the close of the season purchased by the U. S. Fish Commission.

The eggs collected from the fishing-shores and gillers were transferred to the field station at Fort Washington, where they were kept and developed until hardened, so as to permit safe transportation to Central Station, Washington. Here the hatching was completed, and the distribution of the fry conveniently made by car and messenger service. Several million eggs were retained and hatched at Fort Washington for stocking waters in the immediate vicinity of the station.

COST AND RESULTS OF THE WORK.

For the conduct of the work, in accordance with the program submitted and approved, the Commissioner authorized an expenditure not to exceed $5,000. At Fort Washington Station the actual cost of collecting, developing, and transporting the eggs was $2,879.90; at Central Station, for hatching and distribution, $916.55; total, $3,796.45. The total number of eggs obtained was 36,362,000, and the losses during incubation were 6,625,000, leaving the aggregate number furnished for distribution from the Potomac River stations 29,737,000. The percentage of loss during incubation was 18 per cent, and shows marked improvement over the results of previous seasons. The cost of production was $127.66 per million, or 78 shad for each cent of expenditure.

FORT WASHINGTON STATION.

On March 26 the station was occupied by a small force. The men were employed in tarring and rigging the seine, cleaning up the shore, and getting everything in readiness for active work when the run of shad should begin.

The first haul of the Commission seine was made April 12, and the first ripe fish was taken on the 16th. The run of fish steadily increased from that time to the 22d, as did also the proportion of ripe females. On the afternoon and night of the 22d of April 3,503,000 shad eggs were taken and impregnated. This was the maximum number taken in one day during the season. The period of maximum production was from April 20 to 27, inclusive; the total production for the period referred to being 16,017,000, or nearly one-half of the entire number obtained during the season.

The eggs which were hatched and planted in local waters (3,154,000) and forwarded to Central Station (33,208,000) were derived as follows:

From the Fish Commission seine at Fort Washington	11,848,000
From Chapman's Point hauling-seine	5,506,000
From Ferry Landing hauling-seine	4,349,000
From White House hauling-seine	1,487,000
From Stony Point hauling-seine	2,191,000
From the gillers	10,981,000
Total	36,362,000

The records of the Commission seine fished on the Fort Washington reservation have been carefully kept, and are here published, so as to preserve important data in a shape accessible to fish-culturists generally. These show the fluctuations from season to season, not only in the aggregate catch of shad on the same shore, but also the variations in the proportion of males to females, in the time of maximum run, and in the date at which the proportion of ripe fish reaches its maximum, and the interval during which the largest numbers of eggs are taken.

Record of seine-hauling at Fort Washington shore during the season of 1886.

Date.	Number of shad.	Males.	Females.	Ripe females.	Eggs taken.	Temperature of water during impregnation.	Date.	Number of shad.	Males.	Females.	Ripe females.	Eggs taken.	Temperature of water during impregnation.
						°							°
April 15*	2	1	1	....	....	57	May 10‡	......	......	......	....	....	63
16	85	58	27	3	95,000	57	11‡	......	......	......	....	....	62
17	116	88	28	1	40,000	58	12§	150	130	20	7	189,000	65
18	150	111	39	1	7,000	61	13‖	467	385	82	13	385,000	64
19	264	201	63	9	205,000	61	14¶	234	199	35	17	548,000	63
20	216	129	87	5	184,000	65	15†	188	159	29	8	211,000	61
21	238	164	74	6	211,000	63	16*	2	2	0	0	....	63
22	294	194	100	16	391,000	63	17†	215	195	20	3	52,000	66
23	103	62	41	11	386,000	66	18	179	154	25	2	65,000	63
24	200	112	88	27	767,000	69	19	296	195	101	24	824,000	63
25	359	203	156	15	492,000	69	20	170	124	46	11	522,000	65
26	336	168	168	20	705,000	70	21	145	107	38	9	274,000	66
27	185	99	86	20	619,000	68	22	144	96	48	24	611,000	67
28	186	122	64	18	541,000	67	23	164	102	62	22	650,000	71
29	177	97	80	15	464,000	66	24	130	86	44	10	294,000	71
30†	166	121	45	7	195,000	65	25	65	44	21	4	131,000	70
May 1†	38	24	14	3	80,000	62	26	109	79	30	11	239,000	71
2†	289	231	58	2	21,000	63	27	109	88	21	5	161,000	69
3†	202	188	14	0	......	64	28	104	80	24	4	119,000	68
4	207	178	29	5	138,000	64	29	86	66	20	12	389,000	70
5	179	139	40	1	14,000	65	30	75	55	20	3	60,000	71
6†	248	192	56	10	245,000	66	31	31	19	12	6	175,000	69
7†	111	81	30	5	149,000	66	June 1**	5	3	2	0	....	69
8‡	......	......	.....	....	....	64							
9‡	......	......	.....	....	....	63	Total..	7,419	5,331	2,088	395	11,848,000	....

* Seine hauled but once.
† One haul omitted.
‡ No hauls, on account of the high wind or heavy current.
§ Current lighter and running down very fast.
‖ Rain all day.
¶ New current beginning to run.
** Cut seine out after first haul.

A comparison of the records of the seine-hauling in 1885 and 1886, for which seasons only we have reliable records, affords contrasts as interesting as they are perplexing. These may be summarized as follows:

Years.	Total catch.	Males.	Females.	Ripe females in total catch.	Ripe females to entire number of females.	Maximum production of eggs for entire river.	
						Date.	Period.
		Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*		
1885	2,696	45.7	54.3	9.0	17.0	May 16	May 5-11
1886	7,419	71.8	28.2	5.3	14.1	Apr. 22	Apr. 20-27

A considerable proportion of the excess of males was made up of small two-year-old "buck shad," called by the fishermen "skimmers," which, being too small to count, are sold by the bunch. The preponderance of these during the season gives promise of an increased run of full-sized spawning fish in 1887.

Transportation of eggs.—The transfer of impregnated eggs from Fort Washington to Central Station was made by the steamer W. W. Corcoran, plying daily between Washington and Mount Vernon, the transportation being uniformly made on trays, by the "dry method," inaugurated by me in 1881. The total number of eggs forwarded from Fort Washington Station was 33,208,000. Of these 4,925,000 died in transit.

CENTRAL STATION.

The total number of eggs received in good condition, the number of eggs and fry distributed, and the average percentage of loss in hatching are given in the following summary for the season of 1886:

Eggs transferred to other stations	1,586,000
Fish distributed	24,997,000
Eggs lost in hatching, 7 per cent	1,700,000
Total eggs received alive from Fort Washington	28,283,000

The records of the station contain a history of each lot of eggs received from the Fish Commission seine, giving the temperature of impregnation, the maximum, minimum, and mean of water temperatures during the period of incubation, and the percentage of loss in hatching, data which it is important to preserve for reference, but which it is hardly necessary to publish.

Comparison of the catch of 1885 *and* 1886.—The catch of shad in the Potomac varies greatly from one season to another. The aggregate number* taken in 1885 was 157,697; in 1886 it was 275,422, the increase of 1886 over the previous season being 117,725.

* See reports of Gwynn Harris, inspector of marine products, in U. S. F. C. Bulletin, Vol. V, p. 192, and Vol. VI, p. 202.

128.—CATCH OF SHAD IN CONNECTICUT FOR 1885.

By ROBERT B. CHALKER.

The statistics and other information about the catch of shad in the State of Connecticut for the year 1885* are as follows:

POUND FISHERIES.

From the mouth of the Connecticut River to New Haven Harbor:		
15 traps in Saybrook	44,400	
22 traps in Westbrook	52,700	
12 traps in Clinton	26,000	
13 traps in Madison	8,400	
7 traps in Guilford	1,500	
7 traps in Branford	6,500	
3 traps in East Haven	1,800	
Total shore fisheries		141,300

RIVER FISHERIES.

Thames River, hauling-seines		300	
Connecticut River and tributaries:			
Hauling-seines	25,300		
Gill-nets:			
15 at Saybrook	13,500		
18 at Lyme	14,400		
10 at Brockway's Ferry	7,000		
7 at Comstock's Ferry	6,300		
9 at Essex	7,200		
		73,700	
Quinepiac River, 6 hauling-seines		3,500	
Housatonic River:			
16 hauling-seines	33,600		
54 gill-nets	17,000		
		50,600	
Total river fisheries			128,100
Total catch of shad in the State			269,400

This year's catch in the Thames is about double that of 1884, and has been gradually increasing for nine years, while in the Quinepiac the catch is only about one-half as great as in 1884. In the Farmington River, a branch of the Connecticut, there were taken in hauling-seines 3,400 shad, which are included in the report on the Connecticut.

The fishermen on all the rivers of the State report that the pollution of streams by factories and sewerage is yearly destroying great quantities of young fish of all kinds, especially shad. One net owner on the Housatonic says that he has seen "a ton of young shad at one time floating down the river." It is the opinion of shore fishermen that the con-

* For catch in 1886 see Fish Commission Bulletin for 1886, page 297.

struction of jetties and breakwaters changes the movements of the shad. The breakwater at the entrance of New Haven Harbor has so changed the course of the fresh water from the Quinepiac River that it now nearly all flows east, along the Branford shore, the result of which is thought to be a greater catch of shad in that vicinity. For instance, the first pound eastward caught 3,500 shad the past season, the average yearly catch before the building of the breakwater never having exceeded 500. The construction of jetties at the mouth of the Connecticut River causes a distribution of fresh water farther to the westward, and therefore a marked increase in the catch of shad in Clinton and Madison.

Shad fishing in the Connecticut River commenced about April 20, somewhat later than usual, and from that time until May 25 was remarkably good and the shad very large. After that date until the close of the season there was a marked falling off. It was thought that this was caused by the unusually small supply of fresh water in the rivers for that season of the year. The first shad was caught in a gill-net in the Connecticut River, 4 miles from its mouth, on April 18, the temperature of the water that day being 48° Fahr. The same day two shad were caught in a pound 6 miles west of the mouth of the river. As is usually the case, no shad were caught directly at the mouth of the river till six days later. The heaviest run of the season was on May 11 and 12. The highest number caught in one pound was 1,500 at one haul.

The contract price for the season was 20 cents apiece, delivered at the shipping points. The following are the daily prices per shad at the mouth of the Connecticut River for those not sold by contract:

Date.	Price.	Date.	Price.
April 18	$5 00	May 2–5	$0 25
April 19–21	1 00	May 5–12	30
April 21	80	May 12–18	20
April 22	70	May 18–20	15
April 23–27	60	May 20–26	10
April 27–29	30	May 26–June 1	15
April 29–May 1	25	June 1–20	25
May 1	30		

From May 18 to June 1 few could be sold on account of the dull market, and they had to be salted.

There is only one section in the State from which a regular report of the shad catch has been made during the past six years, and it is within these limits that the greater proportion of the shad of the State is taken. The catch for this section is as follows:

Year.	Catch.	Year.	Catch.
1880	269,900	1884	150,100
1881	351,670	1885	190,300
1882	272,900		
1883	177,308	Average	235,363

The section covered by the above table extends from Deep River, situated on the Connecticut River, 10 miles from its mouth, to Madison, 18 miles westward on Long Island Sound.

The following table shows the annual number of shad taken during a period of thirty years by a single pound-net located about 6 miles west of the mouth of the Connecticut River, near Westbrook, at a station called Money Point, the location of the net being the same each year:

Year.	Shad.	Year.	Shad.	Year.	Shad.
1856	3,643	1867	12,500	1878	4,550
1857	5,183	1868	13,000	1879	19,175
1858	6,111	1869	11,000	1880	13,275
1859	3,000	1870	16,558	1881	10,500
1860	6,000	1871	13,508	1882	9,637
1861	6,100	1872	8,271	1883	6,200
1862	6,853	1873	7,343	1884	7,200
1863	10,730	1874	9,290	1885	7,858
1864	12,265	1875	20,037		
1865	9,410	1876	11,041	Total	291,297
1866	10,594	1877	10,465	Average	9,710

In 1872, 1873, and 1874 fishing was allowed by law for only three days a week. In 1878 the nets were much injured by jelly-fish. There was a good run of shad in that year, but it was impossible to continue pound-fishing after May 5. The above table is thought to indicate a fair average of increase in the catch of pound-nets since their introduction in place of hauling-seines, though of recent years there has been somewhat of a falling off. The first pound-net set for shad in the town of Westbrook was in 1849.

SAYBROOK, CONN., *October* 28, 1885.

129.—REPORT ON EXAMINATION OF CLUPEOIDS FROM CARP PONDS.

By TARLETON H. BEAN,

Curator, Department of Fishes.

I have to-day re-examined the *Clupeoids* which were sent over in large numbers from the carp ponds in November and December, 1885, and desire to present herewith a brief report upon them.

Most of the fishes received on the 28th of November were glut alewives, *Clupea æstivalis.* I selected out of the lot 3 specimens, catalogue No. 37380, and 43 specimens, No. 37381. These examples range from 5 to 6 inches in length. There was one specimen of the branch alewife, *Clupea vernalis*, 4¾ inches long, No. 37379. There were also 8 shad, *Clupea sapidissima*, varying from 4 to 6 inches in length, No. 37378. Only two of these shad were of the shorter length.

We did not preserve all of the fishes sent over, but the statement already made will show that the great mass of them were glut alewives and that the percentage of shad was small.

On the 10th of December, 1885, Mr. Hessel sent over upwards of 7,000 *Clupeoids*, consisting almost entirely of shad. In a half-gallon jar, selected at random from the mass of the fish and preserved in alcohol, I have counted 48 shad, catalogue No. 37401, ranging in length from 4 to 5 inches. Thirty-four shad, No. 37403, in another jar, varied in length from $3\frac{7}{8}$ to 5 inches. Another jar contained 17 shad, No. 37404, measuring about the same as the preceding. The total number of shad selected is, therefore, 107. With them were received 13 specimens of the glut alewife, *Clupea æstivalis*, Nos. 37402 and 37405, varying in length from 5 to $5\frac{1}{2}$ inches.

On the 10th of November, 1885, Mr. Hessel sent over a shad, No. 37368, measuring $4\frac{1}{4}$ inches in length. On July 24, 1885, we received from the carp ponds a shad measuring $2\frac{7}{8}$ inches in length, No. 37406.

Shad have been obtained in the United States carp ponds before last year; for example, on November 6, 1880, we received a lot, of which I preserved 23 individuals, No. 26419, ranging in length from 6 to $6\frac{5}{8}$ inches. There has not, however, been such a multitude of shad in the carp ponds until last year, as far as our observation goes, and we are justified in believing that this mass is the result of an experiment by Col. M. McDonald, in April, 1885, at which time about 10,000 young shad were introduced into one of the ponds.

The shad taken in the carp ponds in November of last year represent about the maximum size of the species at the time of the fall migration, as will be seen from reference to the specimens mentioned below.

On September 20, 1874, Dr. J. D. Hyer sent to the Museum a shad taken in the Potomac at Washington, No. 15238, measuring $6\frac{3}{4}$ inches in length. These November shad, taken in the carp ponds and in the Potomac, correspond in size with individuals sometimes taken in the river in the spring. On the 26th of April, 1884, the Fish Hawk obtained 2 shad, No. 37030, at York Spit, measuring $5\frac{1}{2}$ and $6\frac{3}{4}$ inches in length.

Shad of smaller size are also found in the Potomac late in the fall. On the 26th of October, 1881, Col. M. McDonald obtained some specimens, No. 29092, of which 12 are preserved, the smallest measuring 3 inches and the largest 4 inches in length. These in all probability represent a late spawning of the species, and the larger examples previously referred to an earlier one.

In connection with this examination of the shad from the carp-ponds I have again studied a bottle of "whitebait" received from New York Bay in May, 1878, and find that 8 of the fish, No. 21258, are *Clupea æstivalis*, ranging in length from $3\frac{3}{8}$ to $4\frac{3}{8}$ inches, and 2 are shad, *Clupea sapidissima*, No. 37400, measuring 4 inches and $4\frac{3}{8}$ inches, respectively. I mention this here in order to bring out the fact that the time at which shad may be found in salt water is subject to great variation.

U. S. National Museum,
Washington, D. C., January 4, 1886.

130.—ON THE ARTIFICIAL PROPAGATION AND CULTIVATION OF OYSTERS IN FLOATS.

By Prof. W. K. BROOKS.

[From Johns Hopkins University Circular, Vol. V, No. 43.]

Without expressing any opinion as to the value of the process of "fattening" oysters by placing them for a few days in cars floating in fresh water, I wish to point out that there is no similarity between this process and the process of propagation which is here described.

My attention was first called to the value of floating cars in oyster culture by Mr. William Armstrong, of Hampton, Va., who informed me, in 1884, that "seed" oysters which he had placed in floating cars in the mouth of Hampton Creek grew more rapidly, and were of a better shape and more marketable, than those which grew from seed planted on the bottom in the usual way.

One of the results of my study, in 1879, of the development of the oyster was the discovery that there is a period of several hours, immediately after the embryo acquires its locomotor cilia, when it swims at the surface, and this is the period when it is swept into contact with collectors. As soon as the shell appears the larva is dragged down by its weight, and either settles to the bottom and dies or swims for a time near the bottom. The tendency to swim at the surface is an adaptation for securing wide distribution by means of the winds and currents, which sweep the young oysters against solid bodies which may serve for attachment; and the greatest danger to which the oyster is exposed, at any part of its life, is that it may not, at the swimming stage, find a clean, hard surface for attachment.

As it is microscopic and only about half as thick as a sheet of thin paper, it may be smothered by a deposit of sediment or mud so light as to be invisible, and most of the failures to get a good "set of spat" are due to the formation of a coat of sediment upon the collectors before the young oysters come into contact with them.

It occurred to me this summer that this danger could be entirely avoided by the use of floating collectors, for little sediment can fall on a body which is close to the surface of the water, and most of this will be swept away by currents, which will, at the same time, sweep the swimming embryos down into the collector, and thus insure an early, abundant, and successful "set."

I accordingly constructed a floating car, made so as to permit the free circulation of the water. This was filled with clean oyster-shells and moored in the channel in front of the laboratory at Beaufort, N. C., on July 4. As all the oysters in the vicinity were in very shallow water, they were nearly through spawning, and the conditions were therefore very unfavorable; but, notwithstanding this, I immediately secured a

good "set," and the young oysters grew with remarkable rapidity, on account of the abundant supply of food and fresh water which gained ready access to all of them, and the uniform temperature which was secured by the constant change of water.

This method of oyster culture may be applied in many ways, of which the most obvious is the production of seed oysters for planting.

The seed which is used for planting in Maryland and Virginia, as well as in Delaware and further north, is now procured from the natural beds of our waters by tonging or dredging, and as the demand for oysters for this purpose is certainly one of the elements which have led to the depletion of our beds, there is a widespread feeling that the exportation of "seed" should be prohibited.

By a small investment of capital in floating collectors any one on tidewater could easily raise large quantities of much better, cleaner seed than that which is now procured from the natural beds, and if the laws permitted the sale and transportation of this seed without restriction at the season when the demand exists, it could be sold at a profit for less than the cost of tonging.

Northern planters could also raise seed for themselves by constructing floating collectors in the warm water of the sounds of Virginia and North Carolina, where the length of the summer would permit several collections to be made in one season. The oysters thus reared are large enough for planting in five or six weeks, and in the latitude of Beaufort there is an abundance of spat from the middle of April to the 1st of July, and it can be collected until September.

The method may also be used by planters for collecting their own seed, especially in regions remote from a natural supply. If there are no oysters near to furnish the eggs, a few spawning oysters may be placed among the shells in the collector, after the French method, to supply the "set."

It can also be used for the direct production of marketable oysters, especially over muddy bottoms and in regions where public sentiment does not permit any private ownership of the bottom.

As food for the oyster is most abundant at the mouths of muddy creeks, where the bottom is too soft for oyster culture by planting or by shelling, this method will have especial advantage in such places, for there will be no danger of sanding or of smothering by mud at the surface, and there is no limit to the number of oysters which can thus be grown on a given area, for the free current of water will bring food to all of them.

The very rapid growth will more than compensate for the cost of the floats, and Mr. Armstrong's experiment shows that, in addition to all these advantages, the oysters are of a better shape, with better shells and more marketable, than those grown at the same place on the bottom.

Finally, this method will do away with the necessity for a title to the bottom, and will thus enable a few enterprising men to set the example

of oyster culture, and, by the education of the community, to hasten the time when wiser laws will render our natural advantages available for the benefit of our people.

The most economical method of constructing floats must, of course, be determined by practical experiments, but a float constructed by connecting two old ship-masts together by string-pieces, with a bottom of coarse galvanized iron netting, would have sufficient buoyancy and enough resistance to water to support a large quantity of submerged shells and oysters for two or more seasons, and a coating of copper paint each year would protect the timbers from worms.

The floats should be open at the ends, to permit free circulation, and they should be moored in such a way as to swing with the current.

131.—SOME OF THE LIFE-NEEDS OF FISH.*

By Dr. OTTO ZACHARIAS.

Water is the main condition of the life and well-being of fish. The water should contain food in the shape of infusoria, snails, worms, and insect larvæ, but people trust to kind nature to furnish a constant supply of these. In the vast majority of cases this confidence is somewhat well placed, but as a general rule nature will supply only the absolute needs. If a good harvest of fish is to be a certainty, the needs and habits of fish should be thoroughly studied, and care should be taken to remove everything which will interfere with these needs and habits.

Fish breathe through their gills, which consist of four double rows of cartilaginous leaflets. The blood-vessels distributed through them give to the gills a bright red color. Four bony arches support the double lamellæ, which exercise their important functions under a piece of horny skin called the "gill-cover." For the purpose of breathing the fish passes water into the branchial chamber; here it comes in contact with fringe-like leaflets, which it supplies with oxygen. The water makes its escape by the gill-opening. If you take a fish out of the water its breathing process is interrupted, the gill-leaflets begin to shrink, and become dry, when they are unable to absorb the needed air from the atmosphere.

Any one who has carefully examined the gill-fringes of a whiting or pike must be convinced that these tender organs will be injured by muddy or impure water, just as our lungs are injured by inhaling bad air or air filled with particles of dust. The first point to be observed, therefore, should be to prevent water, in which fish are to be kept, from becoming impure by the refuse from factories, mines, &c. Refuse floating in the water will exercise some chemical, but principally a mechanical, influence by constantly irritating the respiratory organs. In this

* "*Ueber die Lebensbedürfnisse der Fische.*" From *Mittheilungen des Westpreussischen Fischerei-Vereins*, No. 5, Dantzic, March 4, 1886. Translated by H. JACOBSON.

respect the refuse from wood-turning establishments must be considered as dangerous, for the fine particles of wood-fiber will easily adhere to the gills and form a basis for fungous growth. This may easily affect the entire fish, and if a river contains a great quantity of small particles of wood-fiber, there is danger that all the fish in it will perish. Trout are particularly liable to be affected by this kind of refuse, and many cool and clear brooks would contain a much larger number of these fine salmonoids if there were fewer paper factories and wood-turning establishments in their valleys. If the refuse contained in the water is not of a soft and flaky character, but is hard, the fish are exposed to hurtful influences of another kind. One of our most prominent zoologists, the late Professor Von Siebold, of Munich, has proved that fish kept during continued rainy weather in a fish-tank, through which passed the water of a brook rendered impure by mud containing small particles of quartz, became totally blind. In this case the constant mechanical irritation produced by small particles of quartz had caused inflammation in the eyes of the fish. They had also received actual injuries in their gills.*

It will be evident that water, as well aerated as possible, and as clear as possible, is the first and self-evident condition required wherever rational fish-culture is to be carried on. The water, however, is not merely the medium of breathing, but is the bearer of food to the fish. If they are to prosper and increase they need a superabundant quantity of food, consisting mainly of living organisms. These in turn need food themselves. But this can be furnished only if the banks are fringed with aquatic plants and if the mud settling at the bottom contains a great deal of humus, so that it may form a food-supplying substratum for numerous microscopic algæ (*Desmidiaceæ*, &c.). All the numberless infusoria and lower crustaceans (varieties of *Cladocera* and *Cyclops*) contained in our waters find their food in this microscopic vegetation, and are, therefore, directly dependent on it. As the young fish live principally on the above-mentioned crustaceans and infusoria, it is evident that anything which causes a decrease in the vegetation of the waters (beyond a certain degree) must exercise an injurious influence on the life and increase of fish. The various organisms in nature are dependent upon each other to a wonderful and complicated degree, and the great in nature is by various ways and means connected with the smallest. When we see refuse and impure fluids from a factory pass into the beautiful clear water of a brook, we think in the first place only of the direct injuries to which fish will thereby be exposed. But the indirect injuries are much greater, because they extend not only to the present generation, but to the organic conditions of life, which, if endangered, will make it questionable whether any fish will in the future be able to live in such water. By the settling of insoluble mineral particles at the bottom of a river its microscopic vegetation is gradually killed, and the

* From a valuable pamphlet on the pollution of water, by Dr. Leuckart, the famous Leipsic naturalist, published by Friedrich Schell, Kassel, 1886.

immediate consequence of this will be that those animals which live on fresh or decayed vegetable matter will disappear. In consequence of this the young fry, if any is raised, is insufficiently fed, and comparatively few fish reach sexual maturity. In this way the fish of our brooks and rivers are constantly decreasing, and, as we have seen, from natural causes, which can be misjudged only by persons who have never studied the needs of fish.

The degree to which the abundance of fish in large water areas is dependent on very small (partly microscopical) animals, which entirely escape the attention of the casual observer, may be observed in the large diluvial lakes in the north of Germany. Last summer I investigated the waters of Holstein, Mecklenburg, and Pomerania, and am able to state, as the general result of my investigations, that those lakes which, among the rural population, had the reputation of being particularly rich in fish were also particularly rich in crustaceans, worms, and infusoria. With a fine gauze net one can in a few minutes catch myriads of small crustaceans and rotifers, so as to cover the bottom of the net to the depth of over an inch with a thick mass consisting entirely of diminutive animals. A person who has not seen the great mass of these little animals brought up at a single haul has no idea of the enormous quantity of living beings contained in a lake with an area of several square miles. An inexhaustible wealth of life moves in the clear waters of such a basin; and in exact proportion to the quantity of small crustaceans and infusoria will be the product of fish.

132.—CALIFORNIA TROUT FOR THE OZARK MOUNTAIN REGION.

By MARSHALL McDONALD.

This species (*Salmo irideus*), which inhabits a restricted geographical range on the west coast, has been largely introduced into the streams of the Eastern and Middle States through the agency of the U. S. Fish Commission. In the spring of 1880, 10,000 eggs of this species were allotted to the Missouri Fish Commission. These were hatched out at the State hatchery and the fry planted in the headwaters of the Gasconade, Osage, and other streams of Southwest Missouri, having their sources in the clear, cold, large flowing springs that abound in the Ozark Hills. Three thousand were planted in the headwaters of Spring River, a tributary of the Arkansas.

A careful inspection of the stream, made in the summer of 1885 by the commissioner of Missouri and others who were familiar with the appearance of the rainbow trout, showed the presence of at least three generations resulting from the original plant. The largest in size weighed between 4 and 5 pounds; those of the second size measured from 15 to 17 inches in length; while the sources of the stream swarmed with thousands of the young from 4 to 5 inches in length.

Accepting the indications of success thus afforded, the United States Commissioner of Fisheries determined to introduce the rainbow trout into the headwaters of all the streams of Missouri, Arkansas, and the Indian Territory, which have their sources in the Ozark Mountains. The area to be colonized is more extensive than the famed Adirondack region of New York. The streams are clear and cold, the temperature of the waters not rising above 58° in the heat of summer. They have every characteristic of good trout streams, and experiment has shown their eminent adaptation to this purpose. It is a wonder that nature has neglected so inviting a field, yet we are informed by the State commissioners of Missouri that no native species of trout is found in any of the streams that rise in the Ozark range. The explanation will probably be found when the history of the development of the surface features of the interior of the continent are known. Be this as it may, it has devolved upon the Commission to utilize nature's neglected opportunities. In August, 1886, fish 4 to 6 inches long were planted:

In tributary of—	Place.	No.
Maramec River	Saint James, Phelps County, Missouri	925
Gasconade River	Newburg, Mo	950
Osage River	Lebanon, Laclede County, Missouri	950
Neosho River	Verona, Lawrence County, Missouri	925
White River	Mammoth Spring, Arkansas	1,110
Total		4,860

Referring to this subject, Dr. I. G. W. Steedman wrote from Saint Louis, Mo., April 6, 1886, concerning specimens of *Salmo irideus* from Verona, Lawrence County, Missouri:

"The eggs from which these trout were hatched came from Baird, Cal., through the U. S. Fish Commission. These eggs were hatched by the Missouri Fish Commission at our Saint Joseph Hatchery, and distributed by our agent to Mr. Montgomery, the owner of the spring at Verona, Mo. There are no trout of any species in the waters of Missouri, naturally, so there can be no question of the authenticity of these trout. This great spring at Verona is a tributary of the Neosho River (a branch of the Arkansas), yet geographically it matters very little, as the White and Arkansas are parallel, and running through the same scope of country, except that the Arkansas has its sources in the Rocky Mountains, and this branch at Verona in the Ozarks of Missouri. I fished with fly in the McCloud River at Baird in 1875. I caught four different varieties of *Salmo*, namely, *irideus*, *spectabilis* ("Dolly Varden," so-called), *quinnat* (California salmon), and a small speckled trout which I cannot name. It was the most numerous and common trout of the McCloud and Sacramento Rivers, and rarely exceeded one pound in weight. In collecting eggs at this station several varieties may have been inadvertently shipped to the East, viz, *irideus*, *spectabilis* ("Dolly Varden"), *Salmo quinnat* (California salmon), or the small speckled trout which I have referred to above."

Vol. VI, No. 29. Washington, D. C. Mar. 24, 1887.

133.—NOTES UPON FISH AND THE FISHERIES.

[Extracted from the official correspondence and compiled by the editor.]

Shipment of soles from England to New York, with general notes on soles.—The following matter was communicated by Mr. E. G. Blackford, in a letter dated New York, November 5, 1885, and comprises information obtained from Mr. William Little, of 32 Scratton road, Southend, England, regarding the English soles. Mr. Little is the fisherman who attended this shipment of soles, caught by himself, from England to New York, which is referred to in the report proper of the Fish Commission Report for 1885, page xxxvii. The statement and notes are as follows:

The soles were caught in what is known as the Swin, on the borders of the North Sea, off Clackton. This locality is about 25 miles from the Thames River and from 1 to 5 miles from the shore, with sandy bottom and water from 3 to 6 fathoms deep. The fish, which were thought to be about six months old, were captured with a beam-trawl of about 1-inch mesh and about 27 score meshes to the beam. The vessel was a small trysail boat of about 14 tons, with a well, in which the fish were placed as soon as taken. Some of the fish had been in the well for several days before being placed in the cans. The soles were shipped at Havarick for Liverpool, being distributed in thirteen cans and five tubs. The cans held about 1 cwt. of water and the tubs about 2 cwts. each. The tubs were built expressly for carrying fish, and had been used for that purpose in sending fish to the London market. The water used was of a temperature of 43° F. The fish were ten hours on the road to Liverpool, where they arrived in excellent condition. Those in the cans were here transferred to four large tubs, each holding about 4 cwts. of water, which had been taken out at sea. These new tubs were rough, and had been used for beer previously. The soles were put on board the Cunard steamer Gallia, which sailed from Liverpool on Saturday, October 24, 1885, at noon. At 4 p. m., as soon as good clear water could be obtained, the water was changed on the fish by allowing a stream from the hose to flow gently into the tubs and overflow for a little time, care being exercised not to disturb the fish much. The water was again changed twice on Sunday, when the fish were still in good condition. Late Sunday afternoon a storm came up, lasting all night and part of the following day. For most of the time the storm was severe, and on Monday morning many of the fish were found thrown out of the tubs upon the deck, some of them being still alive. The motion of the water in the tubs must have been great, as most of the fish left in them were dead, owing to the pounding they had received against the sides, most

of the fish being bruised and scraped severely. Out of the six hundred that were shipped only nineteen were left alive, and of these the last two died on Thursday, October 29, when in mid-ocean.

Fishermen sometimes keep the soles, after taking them from the trawl, alive in the wells of their vessels for as much as eight or ten days before they are sent to market; and it is not a rare thing to find soles alive after lying for a day or two fully exposed on the wet boards at the bottom of the fishing-smack. This shows that they are not a particularly delicate fish. The fishing time for them is from April 1 to the early or middle part of October. Small ones are generally taken early in the season, and large ones later on. The largest soles are taken in the North Sea, in water deeper than 6 fathoms. They grow to about 18 inches in length. Very few other fishes are found on the same bottom where the soles are taken, but minnows and shrimps are often caught in the trawls with the soles. It is not certainly known upon what they feed. The spawning season is after June, or from the latter part of June on, as fish full of roe are taken in May, and others that are spent are taken in July, August, &c. Young of about 1½ inches in length have been taken in February. The soles come into the mouths of the rivers in spring and ascend as far as the water is sufficiently salty, and probably spawn there or along the shores. The temperature of the sea during summer is about 43° F. The price of soles in London ranges from 6*d.* per pound [12 cents], which is very low, to 7*s.* 6*d.* per pound [$1.82], which is very high. The sole is considered the choicest fish in English waters. Among the fishermen it is generally fried.

FOOD FOR SOLES.—Mr. Fred Mather, under date of November 19, 1885, wrote:

I offered them soft clams to eat, and they took the pieces, but invariably ejected them. Then I considered the structure of their horizontal mouth, with teeth on the lower side, and it suggested an implement for pulling up sand-worms (*Arenicola piscatorium*). On following up this suggestion I found that the soles come out of the sand about dusk or a little before, and hunt for and greedily devour the sand-worms that they can find.

PRESERVING FISH WITH BORACIC ACID.—A Scotch firm of dealers in boracic acid as a fish preservative gives the following method for preserving various kinds of white fish, such as haddock, whiting, &c.:

The fish should be steeped (according to their size) from one to six hours in a solution of pure boracic acid, containing 7 ounces of the acid to every gallon of water used. After this treatment, pack in ordinary fish-boxes, and sprinkle slightly with a finely-powdered mixture of one-third boracic acid and two-thirds common salt. The moderate use of boracic acid in food may be regarded as even beneficial, while it is certainly not injurious.*

* For a mode of treating herring with boracic acid, see Bulletin for 1886, page 66.

FISHERY REGULATION IN MANCHOORIA.—The following notification to fishermen was issued in 1885 by the Russian Government. Dr. D. J. Macgowan forwarded a copy, which he had obtained from the Russian consul-general at Shanghai, China, as follows:

"*Fisheries in Manchooria.*—Every vessel going to fish in the waters of Russian Manchooria must go into the nearest harbor from the place where she has decided to fish, and obtain a permit from the official in charge of the harbor or port, and after she has filled up with fish she must return to the same harbor and declare the quantity of fish she has taken on board, and pay duty thereon at the rate of about 10 mex cents per picul,* to wit, 5 kopecks per pood, paper money (2 kopecks=1 mex cent; 36 pounds=1 pood). The same regulation is for seaweed, except that the duty is 5 kopecks per pood in gold. The regulation is intended for this year only."

Dr. Macgowan adds that the northwestern coasts of the Pacific abound with fishes, both in-shore and deep-sea, beyond any other waters of the globe, and these fisheries are destined to enrich Eastern Siberia, to increase the food supply of nations, and to afford employment to the more enterprising of our Cape Cod countrymen, as their skill and daring are needed for developing the Manchoorian fisheries, and who, when unoccupied afloat, as they would be in winter, could act as hunters and lumbermen.

PREPARATION OF SHRIMPS IN CHINA.—Dr. D. J. Macgowan wrote from the United States consulate at Wenchow, China, August 20, 1885, that common shrimps, when captured, are boiled with a little salt and then sun-dried. The larger species (with shells fragile and crispy) are boiled with a dash of salt, sun-dried, beaten in stone mortars with wooden pestles, the mass being then placed in a winnowing machine (an ancient Chinese article, identical with patented ones in the West), when the chitinous integument is scattered out like chaff. It is a toothsome article, and fetches 40 cents per catty retail [30 cents a pound]. The best preparation of shrimps is a paste prepared by grinding between stones.

CARP WANTED IN TASMANIA.—Writing on August 19, 1885, Messrs. August Johnson and A. Marchant, of Circular Ponds, Mole Creek, Tasmania, said:

We have on our farms lagoons of about 3 acres, creeks and natural ponds, with a very mild climate, and if by your aid we could stock them with German carp you would have the hearty thanks of the whole colony, who would be benefited by it.

Will it be possible to forward to this country, from your breeding ponds, either the ova or live breeding fish of the German carp? It takes the San Francisco steamers about twenty-six days to Sydney, and from there we are about three days distant.

---

* One picul=133⅓ pounds, and 5 kopecks=about 3 cents.

The way in which your Government has provided for the people, and the way your fish-breeding establishments are managed, may well excite the admiration of other countries. We have in Tasmania a salmon commission which has been established for twenty-one years, and yet nothing is more scarce than fish, although Tasmania abounds with lakes, lagoons, and rivers.

PROTECTION OF SALMON IN OREGON.—Mr. B. F. Dowell, writing from Jacksonville, Oreg., on October 14, 1885, said:

Although for many years Oregon has passed laws for the protection of salmon, &c., I have known of only two prosecutions under these laws. In 1872 the legislature prohibited the erection of dams across any stream in which salmon or the migrating fish run, without erecting a ladder or fishway, under penalty of from $50 to $500; and the act gave justices of the peace jurisdiction over the offense. Under this act a man was indicted at The Dalles, found guilty, and fined $50 and costs. Recently an action was begun in Jacksonville in a justice's court against E. S. and J. C. Trumble for erecting a dam across Rogue River, which it was alleged obstructed the ascent of salmon. On trial by jury they were found guilty and fined $75 and costs. An appeal was taken and the case next tried in the circuit court. Here the contest was principally over the words "dam or way" in the statute, and whether the dam was high enough to obstruct the passage of the fish. The court charged the jury that if there was a sufficient open way for the fish to pass easily it would be sufficient, whether there was or was not a sufficient open way for the fish to pass up the river. The evidence was conflicting about an open way, and the jury found the defendants not guilty.

A PREPARATION FROM THE GIANT KELP OF THE PACIFIC.—In a letter from Port Townsend, Wash., October 10, 1885, Mr. James G. Swan speaks of an extract or preparation called algin, which he thinks can be made profitably from the giant kelp of the Pacific. He then cites an article by Mr. Stanford which says: "The evaporation is effected in a similar manner to that of gelatine, in thin layers on trays or slate shelves. Thus prepared the sodium alginate presents the form of thin, almost colorless sheets, resembling gelatine, but very flexible. It has several remarkable properties which distinguish it from all other known substances. It bleaches easily, and under pressure becomes very hard. It also makes good paper, tough and transparent, but with no fiber." It is stated also that in some districts of Japan this kelp paper is used as a cheap substitute for window-glass to light the dwellings of the poorer classes.

FISH KILLED BY SUFFOCATION.—Hon. John M. Pearson, writing from Godfrey, Ill., on November 2, 1885, said that in his artificial pond, fed entirely by surface water, he was successful in raising sunfish, crappies, and black bass, the crappie being regarded as the best pan-fish.

The winter of 1884–'85 was very long and cold, and though the ice was frequently cut, the holes quickly froze over. When the ice melted in spring the water was almost covered with dead fish, thousands having died from suffocation. Among the largest were a black bass, 16½ inches long, and weighing, when found, 3 pounds; a crappie, 15½ inches long, same weight; and a jack-salmon (*Stizostedium*), 14½ inches long.

ATLANTIC SALMON TAKEN IN POTOMAC RIVER.—About June 10, 1885, a fish was taken at Mattawoman Point, on the Potomac River, which proved to be the regular Atlantic salmon. As it was probably the first ever seen from the Potomac, the specimen is of great scientific interest. [From letter of Professor Baird to Mr. William E. Stuart, June 14, 1885.]

CONNECTICUT RIVER SALMON.—The first Connecticut River salmon of 1886 was received at Fulton Market the first week in February. It weighed 19½ pounds and retailed at $1.75 per pound, making $34.12 for the whole fish.

LANDLOCKED SALMON EGGS FROM LAKE SUNAPEE.—Mr. Elliott B. Hodge, superintendent of the State hatchery at Plymouth, N. H., writing on January 5, 1886, says: "I took a few thousand landlocked salmon eggs this fall from fish taken in Sunapee Lake. I think that these are the first eggs taken from these fish in waters that have been artificially stocked with them."

On December 9, 1885, a landlocked salmon was speared in Squam River, 34 inches in length, 9 inches in depth, and weighing 15 pounds. The fish was a male, and when taken was in poor condition, while in September the same fish would have weighed nearly 20 pounds. Much larger ones have been captured in Squam Lake. This illustrates the extraordinary growth of landlocked salmon in New Hampshire, where they have been a success in all waters adapted to their habits.

AMERICAN TROUT IN NORWAY.—In the years 1882–'83 the Norwegian inspector of fisheries imported, at the public expense, a parcel of ova of the American trout (*Salmo fontinalis*), with a view to introduce this fish into Norwegian waters, and the result has been so satisfactory that last autumn one of the hatching establishments near Christiania had some 30,000 young fish to offer for sale, which were then about two and a half years old. The result appears to have been welcomed with great satisfaction in Norway, as it proves that this fish is capable of increasing in almost stagnant waters, where the Norwegian trout cannot exist, though its size is smaller. As an example of the success of this experiment it may be mentioned that the Norwegian inspector of fisheries, Prof. A. Landmark, of Christiania, offers these ova at 10 shillings per thousand. [From Nature, April 29, 1886.]

LARGE CATFISH.—We catch an occasional catfish in the Missouri River of great size. I saw one that weighed 110 pounds. [F. W. Avery, Richland, Dak.]

LARGE CATCH OF POLLOCK.—Capt. S. J. Martin, in a letter dated Gloucester, Mass., November 11, 1885, wrote:

The vessels using cod gill-nets, 32 in number, are doing well catching pollock. The most pollock ever received at Gloucester have been landed during the last four weeks. They have been of very large size. averaging 22 pounds. I think these pollock have been on the ground a hundred years, or perhaps a great while longer, yet nobody knew it until the cod gill-nets were used. There will be 400 men getting a living by catching pollock and cod in gill-nets. The pollock of large size will not bite a hook. That has been tried this fall to everybody's satisfaction. I have not seen one pollock of that size taken with a hook. The hand-liners gave it up in disgust.

SHAD, POLLOCK, BILL-FISH, ETC., AT CAPE COD.—Under date of January 2, 1886, Mr. Vinal N. Edwards, who had just returned from a trip on Cape Cod, reports, from Wood's Holl, Mass., as follows:

Messrs. C. K. Sullivan and S. D. Rich, of the Northwestern Weir Company, at North Truro, caught in their traps this fall 86 white shad and about 200 hickory shad (*Clupea mediocris*). Capt. Thomas Smith, of the East Harbor Weir Company, said they caught 60 white shad and about 100 hickory shad. The seven weirs at North Truro each took similar or relative numbers. What they called deep sea shad were the common white shad (*Clupea sapidissima*). Some of the men say they catch about the same number every fall in November, while others say they never caught them before at this season. All the traps are set in 40 feet of water at high tide, and are about a mile from shore. Some of these shad brought in the market as much as $1 apiece, as they were large and fat. Going over to Provincetown, the fish-trap men there said they caught about the same number of shad as at Truro. They say that eighteen or twenty years ago shad were very abundant in the fall, and large numbers were caught in the weirs and salted, selling for a good price during the winter, but not bringing much fresh, but that recently few have been taken, yet always more in fall than spring.

There was a good run of small pollock about 12 to 14 inches long, some of the traps taking as high as 200 barrels at a haul. Mr. C. K. Sullivan sent 75 sugar-barrels of them to Boston at one time and got $5 a barrel. They had had the weir full every day for about two weeks, and had turned them all out, until one man shipped 5 barrels to try the market, and received $7 per barrel. After that these fish were marketed, but they were striking off the coast then, so that comparatively few more were taken.

There was also a good run of bill-fish, some of the weirs being so full that the nets were let down on the bottom to turn the fish out. This was during the last of November, the run lasting about two weeks. As many as 500 barrels were thought to be on hand at one time. They were larger than usual, and would not go through the mesh of the net.

In the fish-market at Provincetown I noticed a small-mouth flat-fish that looked like our common small-mouth flat-fish, but the back was dark brown, with orange-yellow spots all over, and it looked longer than the common flat-fish in proportion to its width, with a sharper nose.*

About Truro they did not catch any menhaden, though usually their weirs were full in the fall. About November 15 the Northwestern Weir Company caught 36 large horse-mackerel. The traps were taken up about December 15, but very little had been taken for the past fortnight.

SHAD CAUGHT IN NOVEMBER.—Mr. E. J. Cory, writing from Tiverton Four Corners, R. I., December 31, 1885, said: "In 1885 I caught a dozen or more of the common river shad; in 1884 I took three or four of them; and in 1883 I caught one, which I then noticed as something unusual. All were taken about November 15, in my traps located on the west side of Sakonnet River, about 1½ miles from the mouth, near what is called Stony Brook. They were set in about 4 fathoms of water at ordinary tides, and about 250 yards from the shore. None of the other fishermen in this neighborhood, so far as I know, have caught any shad at this time of year." In 1886 Mr. Cory removed his traps about November 15, prior to which date he had caught no shad.

Mr. Vinal N. Edwards wrote from Wood's Holl, Mass., January 4, 1886: "I myself saw Lewis Edwards catch three such shad in a fish-trap at Hadley Harbor about November 1, 1885. They were very large."

DO SHAD SPAWN IN SALT OR BRACKISH WATER?—Experiments have been made, with apparently satisfactory results, which show that it is impossible to hatch and bring to maturity the eggs of shad in salt or brackish water. Nevertheless the impression has prevailed and still continues to prevail among the fishermen that shad will actually propagate in other than fresh water.

Mr. Frederick Kirtland, writing on this subject from Saybrook, Conn., November 23, 1886, says:

"Having been engaged in shad-fishing for many years at the mouth of the Connecticut River and along the adjacent shores of Long Island Sound, I have become satisfied, and others agree with me in this, that nearly, if not quite all, the shad we now catch along the shore of the sound are hatched and grown outside of the rivers, either in the sound at or near the mouths of the fresh-water streams, or perhaps some of them may enter these streams. One of my reasons for so believing is that the fishermen in West Brook, Clinton, and Madison, west of the mouth of the Connecticut River, during the spawning season in June, sometimes take 50 or 100 racer or spawned shad in a day, while the fishermen in and near the mouth of the river take almost none. It seems scarcely possible that these spawned fish should have come all the way down the river, escaping the nets and pounds, and then have

* Dr. T. H. Bean pronounced this flat-fish to be *Limanda ferruginea.*

come into the shore 10 or 12 miles from the river, but rather I think these fish deposited their spawn near where they were caught."

Also, Mr. W. B. Tully, writing from Saybrook, Conn., December 13, 1886, says:

"About 3 miles west of the Connecticut River is a small stream called Oyster River, which for the first mile is a salt water creek, and which has a dam less than 2 miles from its mouth, that prevents fish from ascending; yet shad were formerly caught in the deep holes of this stream, sometimes as many as one hundred at a haul. Several days before the nets near the Connecticut River take them, the fishermen 5 or 6 miles west of the river begin to catch shad that have deposited their spawn. Occasionally shad are taken near the mouth of the river in such condition that spawn runs freely from them, in which case it would be impossible for these fish to reach fresh water in which to deposit their spawn. The fishermen here believe that shad are hatched in salt or brackish water."

VARIATION IN NUTRITIVE VALUE OF OYSTERS.—In the Fish Commission Report of 1883, pages 486–488, are statistics of chemical analyses of different kinds of oysters. Those from Norfolk, Va., were secured in April, and the Norfolk dealers have called attention to the fact that at that time of the year their oysters are not in the best condition. So the figures given by Professor Atwater should not be taken as representing the nutritive value of Norfolk oysters at all times of the year. As it is not stated whether these were Lynn Haven oysters, worth $2.50 per gallon, or Elizabeth River oysters, worth 50 cents per gallon, the dealers think less value should attach to the analyses. Probably the samples furnished to Professor Atwater were much poorer than would have been obtained in the autumn or winter. Of course there was no intention to do injustice to Norfolk oysters by taking them in an unfavorable season. Concerning the question as to why oysters should differ in nutritive value, Prof. John A. Ryder has explained in some of his reports that it is due to the amount of nutritive matter stored up as connective tissue in the body, mass, and mantle of the oyster. This tissue varies greatly in amount in different individuals in different seasons. At the end of the spawning season the oyster is exceedingly emaciated in flesh. If such samples were selected for analysis the result would doubtless be very different from the case of those selected when the oysters were in good condition as to flesh or fatness.

BELOSTOMA.—Dr. A. P. Gardner, of Dunning, Pa., has observed a large beetle (*Belostoma americanum*) seizing a fish 3 inches long and holding it fast. The beetle with its sharp claws goaded the fish until dead, then fed upon it, sucking blood or other matter from the fish. After drawing off his pond these beetles arose in the air in early evening and left the place, but when the pond was filled again plenty of them reappeared.

GROWTH OF CARP.—On December 2, 1885, the size and weight of two young carp which were just 5½ months old, and which were reared at the carp ponds in Washington, were as follows, as reported by Dr. Hessel:

Measurements.	No. 1, mirror.	No. 2, leather.
Length from mouth to end of caudal fin .... inches..	12	12½
Vertical height (from dorsal to ventral fin) .... do....	4	4
Circumference .... do....	7¾	8
Weight .... ounces..	17	18

The eggs were obtained by methods which fixed exactly the day of impregnation, which in this case took place on June 15, 1885.

VARIETIES OF GERMAN CARP.—The typical form of the species is what is known as full-scale carp. From this, fish-culturists, availing themselves of the tendency of all animals to break under domestication, and by exercising care in selection, have produced two well-defined varieties, namely, the mirror and the leather carp. In the mirror carp the scales are much larger and more irregular than in the full-scale fish, and portions of the skin are without scale covering. In the extreme form of variation, the leather carp, the scales have entirely disappeared. Between the scale, the mirror, and the leather carp there are an infinite number of intermediate forms, approximating more nearly to one or the other of these distinct varieties. Neither the mirror nor the leather variety can be maintained pure except by careful selection in breeding. It will be found that the progeny of either the mirror or the leather carp will present all the intermediate forms from scale to leather. From each generation it will be necessary to select those individuals for breeders which represent more nearly the form or variety which it is desired to perpetuate.

DISTINGUISHING THE SEX OF FISH.—Mr. Martin Metcalf, of Battle Creek, Mich., writing on February 13, 1886, says:

The experienced fish manipulator can detect the male fish of almost any family at sight, by reason of its smaller, cleaner, slenderer make, narrower and more pointed muzzle, distance between the eyes, and other inexpressible peculiarities, which when once recognized are almost unmistakable.

HOW TO CATCH CRAWFISH.—The following will be of use to carp culturists: (1) Take thirty to fifty osier twigs, or split white-ash sticks, according to the size used, and 3 feet in length, form a bundle of the whole and bind at each end with strong cord or wire, separate the twigs or splints in the center of the bundle by means of sticks 10, 15, and 20 inches long and forked at each end, so that when in place the trap will be spindle-like in shape, with the twigs evenly distributed about its circumference and center, and far enough apart to allow easy entrance for the fish, but from which they will not readily escape. Bait the inside with fresh meat of any kind, only see that it

is fresh and bloody if possible; set the same with the current in running water; if blood can be procured, pour a pint or so on the bait; it will taint the stream for a long distance. I have watched crawfish in great numbers follow up the track or scent thus made from 30 rods below the trap, and have known 6 and 8 quarts taken at a single lift. Should one desire a more substantial and comely rig, it can be made by driving a smooth, stout stick lengthwise through the center of the bundle, slide the tied ends down on the stick until the whole bulges to a diameter of 20 inches or more in the center, fasten the tied ends of the twigs to the center stick, put three hoops of proper size over the whole and fasten with fine copper wire. In order to make hiding places for the crawfish and so retain them in the trap, numbers of the twigs should also traverse it in various directions. [Dr. E. Sterling, Cleveland, Ohio.]

(2) Take an ordinary minnow-net, tie some fresh beef in the bottom, and drop it into the water where there are crawfish. You will soon have more than you have any use for. They will fasten greedily to the meat, and will not let go until taken off. [G. H. Morgan.]

(3) Great quantities of these crustacea are captured in lower Louisiana for the New Orleans market, where they are highly esteemed for making "gumbo," a dish prepared by the creole cooks. The method of capture is simple. A piece of cord two feet long is tied at one end to the middle of a light stick about a foot long. To the other end of the cord is securely tied a small bit of meat, usually fat bacon. An indefinite number of these machines, perhaps two dozen, may be used by one person. He tosses them out into the muddy ponds or "borrow pits," near the levees. He then wades gently through the pond with a pail or basket in one hand, and, visiting each line in turn, slowly raises it out of the water and drops the catch into the receptacle provided.

PRICE OF CARP IN GERMAN MARKETS IN 1884.—In no other place in Germany, and in the same time, is so much sea-fish eaten as in Hamburg. No place eats more carp than Hamburg, and carp bring there three-fourths more than the common sea-fishes. The price is always a middling one between salmon and such common sea-fishes as plaice, cod, &c.; while they sell a great deal higher than herring and shad. Bohemia and Galicia send great quantities of carp to the German markets.

In Berlin good carp cost 1 shilling (English) a pound, salmon 1½ shillings, mountain trout 2 and 2½ shillings, perch 7 and 8 pence, pike (*Esox lucius*) 8 and 9 pence, glass-eyed pike (*Lucioperca sandra?*) 1 shilling. This is nearly the compensation price at the great shops in Berlin, of course varying with offer and demand. For instance, very often at the open market one may buy now in Berlin capital salmon for 1 shilling or 1¼ shillings a pound.

DO TADPOLES EAT CARP EGGS?—Prof. J. W. A. Wright, in a letter from Greensborough, Ala., June 16, 1886, stated that he had been in-

formed by an intelligent man much interested in carp-raising that many of the eggs of his carp had been eaten by tadpoles, after the hind legs of these tadpoles had begun to be pretty well developed, but before they lost their tails.

HATCHING BROOK TROUT EGGS IN RHODE ISLAND.—On June 1, 1886, Mr. Henry T. Root, one of the fish commissioners of Rhode Island, writing from Providence, reported that the 10,000 brook trout eggs forwarded from Northville, Mich., had been hatched in a pure spring stream at Carolina, R. I., giving a trifle over 80 per cent of very strong fish, which were distributed in the waters of Rhode Island without any loss. The hatching record was as follows:

Date.	Temperature of water.	Dead eggs removed.	Date.	Temperature of water.	Dead eggs removed.
1886.	°		1886.	°	
January 28	38	190	March 1	41	23
January 30	40	99	March 3	40	10
February 1	40	78	March 5	42	15
February 3	38	105	March 10	44	26
February 5	37	110	March 13	46	11
February 7	38	110	March 15	48	7
February 9	40	109	March 18	44	10
February 11	42	144	March 22	48	19
February 13	40	96	March 26	46	12
February 15	40	139	March 29	47	17
February 17	40	103	April 3	48	32
February 19	40	53	April 9	52	15
February 21	34	34	April 15	52	18
February 23	41	33	April 20	52	267
February 25	38	20			
February 27	36	23	Total		1,928

A LARGE AMERICAN BROOK TROUT IN ENGLAND.—A very large American brook trout (*Salvelinus fontinalis*) was taken in England, on April 19, 1886, in the ponds of Mr. Basset, of Tehidy, near Camborne. It was 25 inches long and 7 inches deep, and weighed $9\frac{1}{4}$ pounds, being one of a lot with which Mr. Basset stocked his ponds some nine years ago. This one was taken on a ground-line, but the fish is said to give excellent sport when taken on a trolling bait, and it is an exceedingly voracious feeder. The knowledge that the brook trout can attain so great a size in a mere pond in England will probably be a surprise to many, as the weight recorded has rarely been exceeded anywhere. [From Forest and Stream, New York, May 27, 1886.]

A LARGE CALIFORNIA SALMON.—On May 25, 1886, a large salmon arrived in New York from the Columbia River, and lay on the slabs of Mr. E. G. Blackford in Fulton Market, labeled "The largest salmon ever caught." It then weighed 64 pounds, but it is said to have weighed 72 pounds when taken.

CHEAP MACKEREL.—Mr. Eugene G. Blackford made the following statement before the United States Senate Committee on Fisheries, in March, 1886:

"About the first of April (last year) the mackerel fleet struck an immense school of fresh mackerel, and they all loaded up and came into

New York, and there was at one time upward of 15,000,000 mackerel lying around the wharves in the vicinity of Fulton Market. Those mackerel were unloaded there just as fast as possible. Men, women, and children came from all parts of the city with baskets and the wagons of licensed venders, and there was no question about the price. They gave a basketful for 5 or 10 cents and would load a man's wagon for 25 cents. For the space of two or three weeks the poorer classes had the benefit of this immense catch of mackerel. They were distributed all through the city. Of course it was the means of a large class of people making money—not myself, although I am in the fish business. This glut of fish interfered with my business, so to speak, but for the people generally it was a great blessing, especially for the poorer class.

"The single fact, above stated, of itself, in regard to the mackerel fishery, is conclusive. That fishery has been prosecuted with all the perseverance and ingenuity and enterprise that the fishermen of our coast are capable of for one hundred years, and yet there is this enormous take, which goes to prove that man, as a factor, is of no account in depleting the waters of the ocean. Nature has provided for such an immense reproduction that man cannot, with all the many contrivances for catching fish, have any appreciable effect upon the total amount of fish in the sea. This view I came to from examining into the facts, although I had started in favor of protective legislation. Of the statistics that may be attainable with regard to, for instance, the mackerel fisqeries, of which we have figures going back a hundred years or more, and for codfish and other sea-fishes, you will find that, notwithstanding the immense catch and large consumption both for food and for other purposes, these same fish in our markets to-day are just as plenty and just as cheap, and I think somewhat cheaper, because of the increased facilities for catching them."

THE FIRST MACKEREL CATCH OF THE SEASON.—The schooner Ellen M. Adams reached Fulton Market, New York City, April 15, 1886, with the first catch of native mackerel for the season, the take being 28,000 fish, caught off Cape Henry. In Fulton Market the fish sold for 15 cents each, the extra large ones bringing 30 cents.

BLUEFISH ON THE COAST OF NOVA SCOTIA.—Mr. Thomas A. Rich, member of a wholesale fish-dealing firm in Boston, Mass., writing on July 16, 1886, stated that they had just received some fresh bluefish taken in a fish-trap at Barrington, Nova Scotia, and that the shipper reported large quantities on that coast, where they had not before been seen.

SHARK FISHING AT NANTUCKET.—Mr. Albert A. Gardner, of Nantucket, Mass., writing on July 13, 1886, stated that the primary object of shark fishing about Nantucket was sport, the boatmen taking out parties for this purpose. The profit arising from catching the sharks is of a secondary nature. The bait used in fishing is fresh fish, if possible; otherwise, a piece of salt pork is used. The only portions of the shark

having a value are the liver, for the oil it contains, and the jaw, which after being cleaned is worth from $1 to $7, according to size and quality. Many of the sharks taken are worthless, except for the oil contained in the liver, and are simply destroyed.

SHAD FISHING ON THE SAINT JOHN'S RIVER, FLORIDA.—Mr. Joseph Shepard, collector of customs at Saint Mary's, Ga., writing on April 19, 1886, inclosed a letter from Mr. C. L. Robinson, from which the following notes are taken:

The shad season on the Saint John's is from December 1 to about April 8. When they come in they are fat and go into all parts of the river; but on their return to the ocean in June and July, they are very poor and keep low in the deep water, following the channel. Only a small portion of them return, and it is thought that the most die of exhaustion and are devoured by alligators and larger fish. The young shad go down to salt water early in summer, when they are about 1½ inches long.

The first fishing done here specially for shad, was by Captain Waterhouse, of Connecticut, two years before the war. Since the war a considerable business has grown up, till, in the season of 1873–'74, it was estimated that 500,000 were shipped from the Saint John's, mostly to Savannah, from which place they were distributed to various points north.

Our fishermen think that the shad have always been about as abundant as now in the Saint John's, but that the appliances for capturing them have been improved from year to year and more persons have engaged in the business. In this river a net of 4⅞-inch mesh is mostly used, while in the Connecticut one of 5¼-inch mesh is used, as the shad caught here are not so large as those of the Connecticut River.

NOTE ON THE FISHERIES OF SAINT MARY'S RIVER.—April 19, 1886, Mr. Joseph Shepard wrote that the passenger steamer Martha, running on the Saint Mary's River, carried, during the fishing season of 1886, 279 sturgeon, estimated to average 60 pounds each, dressed, consigned to New York by the Mallory steamers, *via* Fernandina, Fla. The steamer Martha also carried for this market and Fernandina about 1,200 shad.

During the season there were also shipped from Fernandina, in 4-gallon cans, about 600 gallons of shrimps, being boiled first and the heads pulled off. A small sloop also fished for sturgeon on the Satilla River, and shipped them north *via* Brunswick, Ga.

REGULATING THE LAKE FISHERIES.—At the meeting of the Michigan fishermen, held in Detroit, resolutions embodying the following propositions were adopted:

(1) That a law should be enacted creating a sufficient number of fish inspectors or wardens to properly inspect each portion of the fishing coast and enforce such regulations and laws as may now or hereafter be in force.

(2) Demanding the passage of a law to punish any fisherman or fish-dealer who catches or has in his possession fish so small as to be unmarketable.

(3) That pound-nets for the catching of whitefish should not be less than 3½ inches in the pot; and that pound-nets for catching herring should have a 2½-inch mesh on the sides and a 3-inch bottom; such herring-nets to be used only between the first day of September and the close of the year.

(4) That discretionary power should be vested in the proper State fishery officers to authorize the use of smaller twine than that prescribed as the legal size, under what may seem to them proper conditions, times, and places.

(5) That a law be passed to prohibit and punish fouling the waters of the State with mill refuse, fish offal, or other substances injurious to fish.

A committee on permanent organization was appointed; also one to draft laws embodying the above declarations for presentation to the next legislature; one to call the attention of our Senators and Representatives to the importance of the fishing interests of the State; and one to petition Congress to impose a duty on Canadian fresh fish and to remove the duty on gilling-twine. [From the Commercial, Port Huron, Saint Clair County, Michigan, March 3, 1886.]

NOTE ON FISHERIES OF ALASKA.—Mr. Peter French, collector of customs at Sitka, Alaska, in a letter dated May 25, 1886, stated that salmon and halibut are brought to Sitka from the "Redoubt," 8 miles south, for shipment to San Francisco. Herring are taken in scows to the oil-works at Killisnoo. Fish and fish-oil are shipped by the regular monthly steamer from all points in Southeastern Alaska. Small boats and canoes are generally used for fishing purposes. The fishing to the westward is done principally by vessels that come up from San Francisco under fishing licenses. The fishing establishments in Southeastern Alaska are Cape Fox, Naha Bay, Kassan, Howcan, Red Bay, Wrangel, Killisnoo, Pyramid Harbor, and Willoughby's Cove.

THE FISHERIES OF ALASKA.—Lieutenant Schwatka says: In its cod fisheries, Alaska is undoubtedly destined to lead the world, if supply and accessibility are worth anything in computation. The shallow shores of East Behring Sea and the submarine plateaus extend in almost every direction from Alaskan shores and simply swarm with cod-fish. To compare them with the Atlantic banks would be like comparing the population of China with that of Hudson's Bay Territory. The waters adjacent to the Alaskan coast have some fine grounds for whale fishing, which are now being occupied for that purpose, and which are yielding about $1,000,000 per annum. But in addition to this vast plateau of whale and cod fishing ground lying off the Alaskan coast, the rivers which run far up into the interior of the country literally swarm with salmon during every season. The Yukon, the Kuskoquim,

and the Kowak are all large rivers emptying into Behring Sea; in fact, the Yukon is one of the largest rivers in the world, and is now reported as having a navigable length of 2,000 miles, and through its whole course there is always an abundance of salmon in the proper season, and well up the other two rivers named the same condition exists. The general atmospheric conditions, however, are vastly different over the inland portion of Alaska from what they are over the coast country and the adjacent waters, but it is not likely that it will ever be necessary to establish fisheries on any of these streams at any considerable distance above their mouths. A limited number of fisheries are now in operation at the mouth of the Yukon River, and there are yet plenty of good sites for the establishment of more of them, and as the business is steadily growing and enlarging there seems to be no doubt but that a vast fishing trade will yet grow up and flourish at the mouth of the great rivers.

With proper fixtures and improvements there is no doubt but that the catching and curing of salmon and codfish can be carried on cheaper here than can be done on any other fishing grounds in the world. In the Alaskan waters the general quality of the fish taken is rather inferior to the fish of the same kinds that are caught on the Atlantic fishing-grounds. They are also reported to be inferior in quality to the Columbia River salmon. A main point involved in the development of this branch of industrial pursuit in Alaska will be the matter of finding consumptive demand for all the salmon and codfish that could be packed in the Alaskan waters more cheaply than such fish can be packed at any other fishing-grounds in the world. It has been the expectation, when all the transcontinental lines of railway get into full operation, that a largely increased movement of Pacific coast salmon and codfish towards the central portion of the country will be developed. With the completion of the Canadian Pacific Railway, it is fair to calculate that this road, with the Northern Pacific road, will be abundantly able to supply all the western half of the Mississippi Valley with fish of the kinds here spoken of at lower prices than they can be furnished from any other source. The expense of shipping canned fish from the mouth of the Yukon River to either Coal Harbor, Port Moody, or Victoria will be light. From any of these points articles can be shipped by rail to any part of the United States.

FISH-CULTURE IN NEW ZEALAND.—Alexander J. Rutherford, honorary secretary of the Wellington and Wairarapa Acclimatization Society, writing from Parliament Buildings, Wellington, April 19, 1886, says that the United States reports on fish-culture are a great boon to those in these islands, who are trying to stock the inland waters with fine varieties of fish. In South Island, the acclimatization societies have been very successful in introducing the brown trout (*Salmo fario*), but in North Island there has been much apathy, and it is only of late years that they have been able to do good work. Some years ago a number

of *Salmo quinnat* were liberated in a few of the rivers, and now doubtful fish are frequently taken, but no one seems to be able to identify them with certainty. *S. fontinalis* do remarkably well in captivity, but are not being seen as yet in the streams in which they have been liberated.

In many of the large rivers the *S. fario* has changed its habits very much, growing very rapidly (2 pounds a year), and frequently in brackish and sea water, where it becomes in appearance very like a sea trout (*Salmo trutta*), and frequently weighs 20 pounds and upwards.

The rivers are teeming with fish-food, larvæ, flies, and millions of a small native smelt (*Retropinna*), as well as various forms of *Galaxias* which force the growth of imported *Salmonidæ* wonderfully. This excess of food seems to alter their habits and appearance very much.

The water that supplies the hatchery at Masterton is an overflow from a river that filters underground through a gravel formation for some miles, coming out of a terrace with a strong flow. Hatching operations have been very successful in this water, though during the summer the temperature has sometimes reached 59° F. As they can at pleasure turn on the stream water, full of insects, they have been able to rear fish in the ponds with but little loss.

The Government is trying to import herring, crabs, lobsters, and other valuable marine life.

PENOBSCOT SALMON PLANTED.—In February, 1885, 100,000 Penobscot salmon eggs were sent from Bucksport, Me., to Mr. E. B. Hodge, Plymouth, N. H., where they arrived February 20. During hatching 765 eggs died. These, together with a loss of 634 young fish, left 98,601 young to be planted. Of these, 5,000 were planted in the Mohawk River, at Colebrook, Coos County, N. H.; 15,000 in the Oliverian River, at Haverhill, Grafton County, N. H.; 10,000 in the Lower Ammonoosuc River, at Littleton, Grafton County, N. H. (all tributaries of the Connecticut River); and the remaining 68,601 were planted by the Vermont commissioners in eight tributaries of the Connecticut.

LANDLOCKED SALMON PLANTED.—On March 28, 1885, Mr. E. B. Hodge received at Plymouth, N. H., from Grand Lake Stream, Maine, 25,000 landlocked salmon eggs, of which but 13 were found to be dead. During the hatching 375 more were lost, which with 725 young fish that died made a total loss of 1,113. The remainder were planted June 18, 1885, in Clyde River, Derby, Vt., about five miles from Lake Memphremagog.

MACKEREL MOVEMENTS.—John F. Holmes, keeper of Gurnet's Life-Saving Station, wrote on September 18, 1885, that during the previous four weeks very few large bodies of mackerel had been seen, but there were more or less broken schools that had remained there during the summer. On Tuesday, September 15, large schools of mackerel made their appearance, followed by about twenty vessels of the mackerel fleet. He thought that these mackerel were part of the eastern school on their way south. On September 20 the body of mackerel appeared to have passed by.

Vol. VI, No. 30. Washington, D. C. Mar. 24, 1887.

134.—SOME OF THE FISHERIES OF WESTERN FLORIDA.

By SILAS STEARNS.

With its extensive sea and gulf coast and its great interior water supply, Florida has an abundance of food-fishes, easily accessible to nearly every portion of the State. For a long time the fishing in Florida waters was done by the farmers and settlers for home consumption, while with the growth of the larger towns local fishing industries arose simply to supply the immediate neighborhoods, and a small traffic with Cuba gradually sprung up. The most important fisheries of Florida, however, are but ten or fifteen years old.*

Statistics of persons employed, apparatus and capital, and products of the Florida fisheries in 1880 *and* 1884.

	1880.		1884.*	
	Amount.	Value.	Amount.	Value.
Fishermen .... number..	2,194	....	2,700	....
Shoremen .... do....	285	....	400	....
Total persons employed .... do....	2,479	....	3,100	....
Vessels .... number..	142	$248,200	211	$365,755
Boats .... do....	743	15,558	1,061	22,750
Minor apparatus	....	21,923	....	38,140
Additional invested capital	....	39,963	....	63,255
Total capital invested	....	325,644	....	489,900
Mullets .... pounds..	4,225,505	117,391	4,864,130	97,282
Groupers .... do....	1,764,000	141,120	1,230,000	86,100
Red snappers .... do....	1,483,292	66,756	3,551,264	124,294
Pompanos .... do....	14,212	1,421	56,000	5,000
Bluefish .... do....	69,250	1,385	110,625	2,212
Other kinds of sea fishes .... do....	2,994,735	87,594	3,000,000	60,000
Sponges .... do....	165,000	185,000	200,000	200,000
Turtles .... do....	180,000	7,200	300,000	10,500
Terrapins .... do....	3,000	200	....	....
Shrimps .... do....	71,750	3,500	....	....
Clams	4,800	330	....	....
Oysters	324,280	16,270	75,000	45,000
Mullet roes	13,325	5,867	15,000	3,000
Alewives .... pounds..	10,000	200	....	....
Shad .... do....	251,700	20,136	....	....
Sturgeon .... do....	3,000	150	....	....
Other kinds of river fishes .... do ...	402,750	11,850	....	....
Total value of products	....	666,370	....	633,388

* The statistics for 1884 are an estimate for Western Florida alone.

The mullet fishery.—The mullet occurs everywhere about the coast, and for a large part of the year is the most abundant and easily secured of the fishes. In season it is an excellent food-fish, ranging in weight

*For the sponge, red snapper, and grouper fisheries, see F. C. Report for 1885, p. 217.

from 1 to 5 pounds. It is most extensively pursued during the fall months, when it is schooling, seines being run around the schools and great quantities often taken.

Stations are selected at the most favorable points along the coast, where crews of fishermen are employed for several months. The greater part of their catch is salted, and a considerable quantity is sent in ice to the nearest railroad connection, whence the fish are shipped to the interior. The mullet is rather better in a salted condition than most Southern fishes, and approaches the mackerel in excellence.

The most valuable stations, which are on the southwest coast south of Tampa Bay, are worked to supply the demand for salt mullet in Havana. North of Tampa Bay, on either side of the peninsula, the catch is sold to the nearer markets in Florida, Georgia, and Alabama. While the fishing is going on the stations are visited by many customers from the country, who travel with ox-carts and are prepared to carry their purchases home with them. The roes of the mullet are always saved, and prepared for sale by being lightly salted and then dried.

Almost every coast settler in Florida has a cast-net with which to supply his table with mullet. During the first four months of the year there is one species of mullet in good condition, and about the time this has become poor another species has become edible and continues good until December, so that an almost constant supply of good mullets is easily available.

The pompano and other fisheries.—Pompanos are caught in small schools in shoal water along the sea beaches, where it feeds upon shell-fish. During seasons when they are scarce they bring very high prices, the fishermen sometimes getting $1 apiece for them, while when abundant they sell for 5 or 6 cents apiece. They average 1½ pounds in weight, occasional specimens reaching up to 6 pounds. Another species of pompano, of inferior edible qualities, sometimes grows to a weight of 20 pounds.

Spanish mackerel are taken in seines and gill-nets, as it occasionally comes into shoal water within their reach. It is readily sold for a good price during the period of its "run," and would appear in market much longer if there was some economical way to capture it in deep water, where it occurs in abundance for several months.

Bluefish are taken with the Spanish mackerel, though not so salable as this species or the pompano, as the bluefish do not endure handling or transportation so well as these. It is very abundant at times. When inclosed in large numbers in nets it is very destructive to the twine, and is therefore shunned by the fishermen when other fish can be taken.

Sea trout, redfish (or channel bass), and sheepshead are taken on grassy bottoms mainly in the bays and lagoons. Trout and sheepshead sell for about the same price as bluefish, but comparatively few are handled by shippers. The redfish are more abundant, but are considered inferior in quality and are not utilized to any great extent.

The shad fishery.—The river fisheries of commercial importance are confined to the Saint John's River, where shad are taken by gill-nets in considerable numbers. The season for shad being earlier here than at other points on the Atlantic coast the catch is sometimes very profitable to the fishermen, and many men look to this fishery for support. During the last few years, however, the catch has been small, and the supply seems to be somewhat exhausted.

The oyster fishery.—There is a large supply of good oysters, it being estimated that there are more than 12,800 acres of edible oysters in the waters of Florida. They occur in natural beds in the salt and brackish waters of the bays of the northern parts of the State, on the east and the west coasts. Along the shores of the southern part of the peninsula are large reefs of a small oyster known as "coon oyster" or "tree oyster," the latter name referring to their growing upon the tide-washed roots of the mangrove. These oysters are so small that they have no commercial value. The only method of gathering oysters in Florida is by using the ordinary oyster-tongs. Appalachicola has recently been doing a thriving business in canning the excellent oysters of that vicinity. Most of the fresh oysters of Florida are consumed locally.

PENSACOLA, FLA., *October* 15, 1885.

135.—NOTES ON THE HISTORY OF PREPARING FISH FOR MARKET BY FREEZING.

By A. HOWARD CLARK.

For very many years in Russia and in other cold countries fish and meats have been frozen for market by exposure in the open air or by freezing them *en masse* in ice. In Thibet as early as 1806 the flesh of animals was preserved frost-dried—not frozen—and in that condition would keep, without salt, for several months.

In the United States ice was first used for the preservation of fish about the year 1842, and in 1845 fishing-vessels began to take ice to preserve their catch. At first they were careful to keep the ice separate from the fish, piling it in a corner of the hold, but they soon began packing the fish in broken ice. The inland trade in fresh fish had, up to that time, been very limited, but soon increased, and it was not many years before boxes of fish packed in ice were shipped far inland.

The trade in fish frozen by artificial means began about the year 1861, when Enoch Piper, of Camden, Me., obtained a patent (No. 31736) for a method of preserving fish or other articles in a close chamber by means of a freezing mixture having no contact with the atmosphere of the preserving chamber. The patent was issued in March, 1861. Mr. Piper states that the most important application of his invention is for the preservation of salmon, which had heretofore been preserved in a fresh state only by being packed in barrels with crushed ice, which on

melting had moistened and injured the fish. The ice, it was said, could not keep the fish more than a month, whereas, by the new method they could be kept for years if need be. The apparatus used is described as a box in which the fish are placed in small quanities on a rack; the box has double sides filled in between the sides with charcoal or other non-conducting material. Metallic pans filled with ice and salt are set over the fish and a cover shut over the box. About twenty-four hours were required to complete the freezing, the freezing mixture being renewed once in twelve hours. "The fish may afterwards be coated with ice by immersing them in iced water or by applying the water with a brush. They may then be wrapped in cloth and a second coating of ice applied, or they may be coated with gum-arabic, gutta-percha, or other material to exclude the air and to prevent the juices from escaping by evaporation." The fish are then packed closely in a preserving box, which is without a cover, but within a covered box, the space between the boxes being filled with charcoal or other non-conductor. Metallic tubes pass through the inner box for the introduction of the freezing mixture, a small pipe connecting with the lower end of the tubes to carry off the brine. The combined area of the tubes is required to be one-fifth the area of the inner box in order to keep the temperature below the freezing-point.

Numerous and complex methods of fish-freezing have been invented and more or less practiced since Mr. Piper obtained his patent. The latest improvements are the simplest and perhaps the most effective.

In 1869 Mr. William Davis, of Detroit, patented a freezing-pan for fish, which he describes as a thin sheet-metal pan or box, in two sections, one made to slide over the other, the object being to place the fish or meat in one section or part and to slide the other part over it and in close contact with the articles to be frozen. The boxes are then to be piled in a large close wooden box, the double sides of which are filled in with charcoal or other non-conducting material. Ice and salt is packed over and about the metal pans. In from thirty to fifty minutes the contents are frozen solid and may be taken from the pans and packed in the keeping chamber, where the temperature is constant at 6° to 10° below the freezing-point.

Mr. Davis in the same year obtained another patent for a preserving chamber, which he says may be a room or box of any desired form. It has double walls, with the intervening space filled with a non-conducting substance. Within this are metal walls of less length than the outside walls, so that between the two a freezing mixture may be placed. Entrance is obtained through the top or side by closely-fitting doors or hatches.

Other methods have been practiced, such as putting the fish in rubber bags or in other waterproof material and packing them in ice and salt. One method is described as a series of circular pans, seven in number, of such dimensions as to fit in a barrel, and in these pans the fish

are frozen. In 1880 Mr. D. W. Davis obtained a patent (226390) for packing fish and finely-crushed ice in a barrel and freezing the same solid, the fish being so stowed as not to come in contact with one another.

In Boston, New York, and other cities entire buildings of three to five stories or floors are now made into fish-freezers and cold storage for fish. The most common method of producing the cold air requisite for freezing is by the use of ice and salt in metallic chambers or large tubes, which pass perpendicularly through the freezing-room. The freezing-room is provided with double walls interlined with some non-conductor. The fish are either hung on hooks or spread on shelves until frozen, when they are removed to the cold storage-rooms and kept for months, if need be, before marketing.

WASHINGTON, D. C., *March* 27, 1886.

136.—A LIST OF THE BLANK FORMS, CIRCULARS, AND MINOR PUBLICATIONS OF THE UNITED STATES FISH COMMISSION, FROM AUGUST 1, 1884, TO MARCH 1, 1887.*

By CHARLES W. SCUDDER.

501. Blank book for record of salmon and alewives taken. 8 columns. August 6, 1884. 1 folio, 17 by 20.5 cm. Bound. 12 folios.

502. Blank requesting Smithsonian Institution to forward Fish Commission publications to parties named. August 8, 1884. 1 p. 9.5 by 17 cm.

503. Blank for inclosing vouchers for certification. September 9, 1884. 1p. 20 by 26 cm.

504. Blank for compiling the names of carp applicants by Congressional districts. 7 columns. Reprint of No. 320. October 20, 1884. 2 pp. 20 by 25 cm.

505. Blank for sworn certificate of traveling expenses. October 30, 1884. 1 p. 16.5 by 20 cm.

506. Blank book for liabilities of the U. S. Commission of Fish and Fisheries. 7 columns per folio. November 4, 1884. 1 p., 20 by 25 cm. Bound. 28 pages.

507. Blank book for record of temperatures and soundings for the steamer Albatross. 16 items. 5 columns. November 7, 1884. 1 p., 11 by 24 cm. Bound. 100 pages.

508. Blank for return for directory of Fish Commission employees. 8 items. December 5, 1884. 1 p. 20 by 25 cm.

509. Blank book for quarterly balance of property of the U. S. Fish Commission. 12 items. 24 columns. December 2, 1884. 1 p. 20 by 31 cm.

510. Blank for memorandum to Professor Baird for approval. December 17, 1884. 1 p. 20 by 25 cm.

511. Blank label to attach to Fish Commission publications. December 30, 1884. 1 p. 7.5 by 14 cm.

512. Blank book for articles on hand at close of quarter. 22 columns. January 1, 1885. 1 p., 33 by 45 cm. Bound. 300 pages.

513. Post-card referring applicants for Fish Commission Bulletin to their members of Congress. January 6, 1885. 1 p., and penalty notice on reverse. 7.5 by 13 cm.

514. Letter heading "Laboratory of the U. S. Commission of Fish and Fisheries, Washington, D. C." December 30, 1884. 1 p. 20 by 25 cm.

---

* This is a continuation of the list in Fish Commission Bulletin, Vol. IV, p. 397.

515. Blank for disbursing agent's report to the chief of the property division of articles paid for. 6 columns. January 24, 1885. 1 p. 21 by 27 cm.

516. Circular notice regarding telegraph messages of the U. S. Fish Commission, and giving rates of pay for communications by telegraph. February 6, 1885. 1 p. 8 by 14.5 cm.

517. Envelope for U. S. Commission of Fish and Fisheries, without penalty notice, for foreign use. February 10, 1885. 1 p. 8.5 by 15 cm.

518. Record of ocean temperatures. Blank for recording time, temperatures, winds, weather, and movements of fish. 20 columns. June 29, 1885. 1 p. 35.5 by 43 cm.

519. Circular letter asking persons to file receipt for carp. Reprint of No. 422. February 28, 1885. 1 p. 8 by 13.5 cm.

520. Circular letter asking for receipt for Fish Commission publications. March 28, 1885. 1 p. 14 by 16.5 cm.

521. Blank for ordering pamphlet publications sent to persons named in letters. April 1, 1885. 1 p. 11 by 15 cm.

522. Blank for double fish-egg ticket. 9 items. April 6, 1885. 1 p. 13 by 13 cm.

523. Post-card, daily report of eggs taken and fish on hand. 6 items. 5 columns. April 22, 1885. 1 p., with return address and penalty notice on reverse. 7.5 by 13 cm.

524. Blank for balance-sheet of property records. 7 columns. April 17, 1885. 1 p. 20.5 by 35 cm.

525. Circular letter transmitting accounts upon vouchers and instructions concerning signatures. Reprint of No. 460. May 7, 1885. 1 p. 8.5 by 20 cm.

526. Blank label for Albatross medical department. May 13, 1885. 1 p. 4 by 6.5 cm.

527. Blank for sub-voucher. To accompany No. 555. May 21, 1885. 1 p. 8.5 by 20 cm.

528. Scrip heading "U. S. Commission of Fish and Fisheries." Note size. June 28, 1885. 1 p. 12.5 by 20 cm.

529. Blank book for abstract of disbursements by H. A. Gill, disbursing agent of the U. S. Fish Commission. 6 columns. June 20, 1885. 1 p., 25 by 37.5 cm. Bound. 80 pages.

530. Blank for abstract of disbursements by H. A. Gill, disbursing agent of the U. S. Fish Commission. 7 columns. June 20, 1885. 1 p. 20 by 32 cm.

531. Check-list of 1,000 numbers. 9 columns. July 15, 1885. 1 p. 21 by 35 cm.

532. Return envelope, "William A. Wilcox, agent U. S. Commission of Fish and Fisheries," with penalty notice attached. July 5, 1885. 1 p. 7.5 by 19.5 cm.

533. Circular letter to goldfish applicants, stating that they will be supplied as soon as practicable, and that due notice of shipment will be sent. Hektograph. November 10, 1884. 1 p., and penalty notice on the reverse. 7.5 by 13 cm.

534. Blank for order for carp. Hektograph. November 10, 1884. 1 p., and penalty notice on the reverse. 7.5 by 13 cm.

535. Circular letter to carp applicants inclosing an order for carp. Hektograph. November 10, 1884. 1 p. 20 by 25 cm.

536. Circular letter offering salmon trout, brook trout, California trout, and white-fish ova. Hektograph. December 2, 1884. 1 p. 20 by 25 cm.

537. Blank for compiling data of the condition of the Chesapeake Bay oyster-beds from material collected by a diver. 20 items. Hektograph. December 13, 1884. 1 p. 20 by 31 cm.

538. Circular letter giving classification and rates of compensation for employees in the messenger service of the U. S. Fish Commission. Hektograph. December 15, 1884. 1 p. 20 by 32 cm.

539. Circular letter giving the names of employees assigned to duty and their position in the messenger service of the U. S. Fish Commission. Hektograph. December 20, 1884. 1 p. 20 by 32 cm.

540. Circular letter to employees in the messenger service of the U. S. Fish Commission inclosing and calling attention to Nos. 538 and 539. Hektograph. December 24, 1884. 1 p. 19 by 24 cm.

541. Circular letter forwarding diploma awarded at the London Fisheries Exhibition. March 11, 1885. 1 p. 20 by 25 cm.

542. Blank for receipt of diploma of London Fisheries Exhibition. March 11, 1885. 1 p. 10 by 22 cm.

543. Circular letter of invitation to visit the Central Hatching Station of the U. S. Fish Commission. May 28, 1885. 1 p. 20 by 26 cm.

544. Circular letter asking fishermen to fill out blank No. 545, inclosed. July 1, 1885. 1 p. 21.5 by 28 cm.

545. Blank for reporting the quantity of mackerel taken, where taken, number of empty barrels purchased in the Provinces, value of vessel, &c. 26 items. July 1, 1885. 1 p. 21.5 by 28 cm.

546. Blank book for record of applications for miscellaneous fishes. 5 columns per folio. October 10, 1885. 1 p., 26 by 38 cm. Bound. 250 folios.

547. Blank book for record of applications for goldfish and golden ides. 10 columns per folio. October 10, 1885. 1 p., 26 by 38 cm. Bound. 250 folios.

548. Blank book for record of application for shad. 9 columns per folio. October 10, 1885. 1 p., 26 by 38 cm. Bound. 250 folios.

549. Blank book for record of applications for whitefish. 9 columns per folio. October 10, 1885. 1 p., 26 by 38 cm. Bound. 250 folios.

550. Blank book for record of applications for trout. 10 columns per folio. October 10, 1885. 1 p., 26 by 38 cm. Bound. 250 folios.

551. Blank book for record of applications for salmon. 10 columns per folio. October 10, 1885. 1 p., 26 by 38 cm. Bound. 250 folios.

552. Blank book for record of requisitions. 7 columns per folio. October 10, 1885. 1 p., 19 by 25 cm. Bound. 250 pages.

553. Blank book for record of vouchers. 6 columns per folio. October 10, 1885. 1 p., 19 by 25 cm. Bound. 250 pages.

554. Blank card for memorandum of accounts with U. S. Fish Commission employees. Period covered, when paid, amount, and compensation. October 27, 1885. 1 p. 10.5 by 17 cm.

555. Blank for voucher. Account of expenses of propagation of food-fishes, 1886. November 19, 1885. 1 p., and filing blank on reverse. 20 by 25 cm.

556. Blank for State fish commissioners to fill. 8 questions. Hektograph. November 10, 1885. 1 p. 20 by 31 cm.

557. Circular letter inclosing carp application. Revise of No. 463. November 24, 1885. 1 p. 13 by 20 cm.

558. Return envelope. Prof. Spencer F. Baird, Sea Fisheries Investigation, 1885, with penalty notice attached. November 24, 1885. 1 p. 10 by 22 cm.

559. Circular letter to carp applicants calling attention to misleading statements in newspapers regarding fish-culture. November 30, 1885. 1 p. 10 by 22 cm.

560. Circular letter announcing the sending of "The Fishery Industries of the United States." Hektograph. February 15, 1886. 1 p. 20 by 25 cm.

561. Plotting blank for temperature chart of air temperature, surface temperature, and bottom temperature; with blanks for name of station and observer. December 19, 1885. 1 p. 27 by 60 cm.

562. Post-card to applicants for "The Fishery Industries of the United States," referring them to the Public Printer. January 4, 1886. 1 p. 7.5 by 13 cm.

563. Blank label to attach to Fish Commission publications, with penalty notice. January 4, 1886. 1 p. 10 by 17.5 cm.

564. Blank for acknowledging receipt of letter, and announcing carp literature as sent to party named. January 15, 1886. 1 p. 20 by 25 cm.

565. Blank slip for attaching to accounts certifying that mileage charged was made under orders and at personal expense. January 18, 1886. 1 p. 7.5 by 20 cm.

566. Circular notice regarding telegraph messages of the U. S. Fish Commission, and giving rates of pay for communications by telegraph. January 16, 1886. 1 p. 8 by 14 cm.

567. Circular letter relating to the sea fisheries for 1885, and questions as to quantity of mackerel, halibut, cod, herring, and other fish sold fresh and dry-salted. February 9, 1886. 1 p., 21 by 27.5 cm. 4 pages.

568. Circular letter relating to the Great Lakes fisheries, and questions as to the kind of apparatus used and quantity of fish taken. August 15, 1885. 1 p. 21 by 27.5 cm.

569. Post-card notice of transfer of fish or eggs. Return address and penalty notice on reverse. March 3, 1886. 1 p. 7.5 by 13 cm.

570. Circular letter relating to the Great Lakes fisheries, and questions as to the kind of apparatus used and quantity of fish taken. Revise of No. 568. January 27, 1886. 1 p. 21 by 34.5 cm.

571. Blank for owners of fisheries of the Great Lakes to fill : Names of persons employed, number and kinds of boats, number and kinds of nets, quantity and value of fish. To accompany No. 568. August 15, 1885. 1 p. 27 by 39.5 cm.

572. Blank for property return. 7 columns. Hektograph. June 15, 1885. 1 p. 20 by 31 cm.

573. Circular illustrating the development of the Spanish mackerel. Thirteen figures and explanations. Hektograph. June 2, 1885. 2 pp. 20.5 by 32 cm.

574. Invitation for proposals for filling inside of retaining-wall at Wood's Holl Station. Hektograph. April 10, 1885. 1 p. 20 by 31.5 cm.

575. Post-card announcing supply of carp pamphlets exhausted, and that a copy will be forwarded as soon as received from the printer. Hektograph. November 18, 1885. 1 p., and penalty notice on reverse. 7.5 by 13 cm.

576. Post-card to goldfish applicants stating that the stock is exhausted, and that they will be supplied next fall. Hektograph. April 15, 1885. 1 p., and penalty notice on reverse. 7.5 by 13 cm.

577. Circular letter to goldfish applicants stating that the general distribution is completed, and that they will be supplied at next fall distribution. Hektograph. April 15, 1885.

578. Circular letter announcing that Charles G. Atkins will forward eggs of landlocked salmon. Hektograph. February 8, 1886. 1 p. 19 by 24.5 cm.

579. Circular letter acknowledging the receipt of application for trout and stating that arrangements should be made to receive the fish at the fish station. Hektograph. December 15, 1885. 1 p. 19 by 24.5 cm.

580. Circular letter to State commissioners offering lake trout and whitefish. Hektograph. November 19, 1885. 1 p. 19 by 24.5 cm.

581. Circular letter to carp applicants in Canada advising them to wait for fish till fall distribution. Hektograph. January 8, 1886. 1 p. 19 by 24.5 cm.

582. Circular letter inviting bids for grading at the carp ponds. Hektograph. May 20, 1885. 1 p. 19 by 24.5 cm.

583. Circular letter to collectors of customs asking for list of fishing-vessels. Cyclostyle. February 17, 1886. 1 p. 20 by 25 cm.

584. Circular letter to the Commissioner of the Bureau of Navigation, Treasury Department, transmitting Nos. 585 and 586. Cyclostyle. February 17, 1886. 1 p. 20 by 25 cm.

585. Circular letter to collectors of customs, announcing that statements of fishing-vessels received are satisfactory. Cyclostyle. February 17, 1886. 1 p. 20 by 25 cm.

586. Circular letter to collectors of customs, inclosing incomplete statements of fishing-vessels for completion. Cyclostyle. February 17, 1886. 1 p. 20 by 25 cm.

587. Blank book for statement of expenditures at Fish Commission stations. 14 columns per folio. March 28, 1886. 1 p., 28 by 44 cm. Bound. 50 pages.

588. Circular letter relating to information asked on the sea fisheries, to accompany No. 567. January 25, 1886. 2 pp. 21 by 27 cm.

589. Blank book: The United States in account with Herbert A. Gill. 9 columns per folio. April 17, 1886. 1 p. 26 by 35.5 cm.

590. Blank slip for certificate that immediate delivery of articles was necessary. April 21, 1886. 1 p. 7.5 by 20 cm.

591. Label for packages to "Prof. S. F. Baird, Wood's Holl, Mass.," with penalty clause attached. July 17, 1886. 1 p. 4 by 13.5 cm.

592. Blank for shipping articles for U. S. Fish Commission vessels. 17 columns. September 6, 1886. 1 p. 45 by 53 cm.

593. Official envelope, "U. S. Commission of Fish and Fisheries, steamer Albatross," with penalty notice attached. November 2, 1886. 1 p. 8.5 by 15 cm.

594. Official envelope, "U. S. Commission of Fish and Fisheries, steamer Albatross," with penalty notice attached. November 2, 1886. 1 p. 10 by 23 cm.

595. Circular letter transmitting check with blank for receipt for check attached. November 17, 1886. 1 p. 20 by 25 cm.

596. Blank for description of ponds. 38 questions. November 20, 1886. 4 pp. 21 by 35 cm.

597. Blank for request for transportation, with blank certified receipt. Stub attached for 10 entries. Series B. November 23, 1886. 1 p., 16 by 31 cm. 10 volumes, 100 pages each.

598. Letter-head, "U. S. Commission of Fish and Fisheries, steamer Albatross." November 24, 1886. 1 p. 19 by 24 cm.

599. Circular letter to Congressmen calling attention to their indorsement on an unauthorized carp blank issued by the U. S. Fish Co. November 24, 1886. 1 p. 20 by 25 cm.

600. Circular letter to owners and masters of fishing vessels transmitting No. 601. Cyclostyle. November 30, 1886. 2 pp. 19 by 24 cm.

601. Blank for "Statistics of New England Vessel Fisheries, 1886." November 30, 1886. 2 pp. 21 by 27 cm.

602. Circular letter and blank relating to "Statistics of the Mackerel, Cod, and other Fisheries for 1886." November 10, 1886. 4 pp. 21 by 28 cm.

603. Blank for requisition of articles or labor, with "Instructions" on the reverse. Revise of No. 465. January 18, 1887. 2 pp. 20 by 24.5 cm.

604. Label for trout eggs, giving instructions for their care. February 8, 1887. 1 p. 18 by 25 cm.

605. Circular letter and questions relating to mackerel and the mackerel fisheries. 25 questions. February 28, 1887. 4 pp. 21 by 27.5 cm.

606. Return envelope, "U. S. Fish Commission, Washington, D. C.," with penalty notice attached. February 28, 1887. 1 p. 10 by 22 cm.

INDEX TO THE FOREGOING LIST OF BLANKS, CIRCULARS, ETC.

[NOTE.—The references are to the numbers and not to pages.]

INDEX.

C.

D.

Y.

Z.

3010